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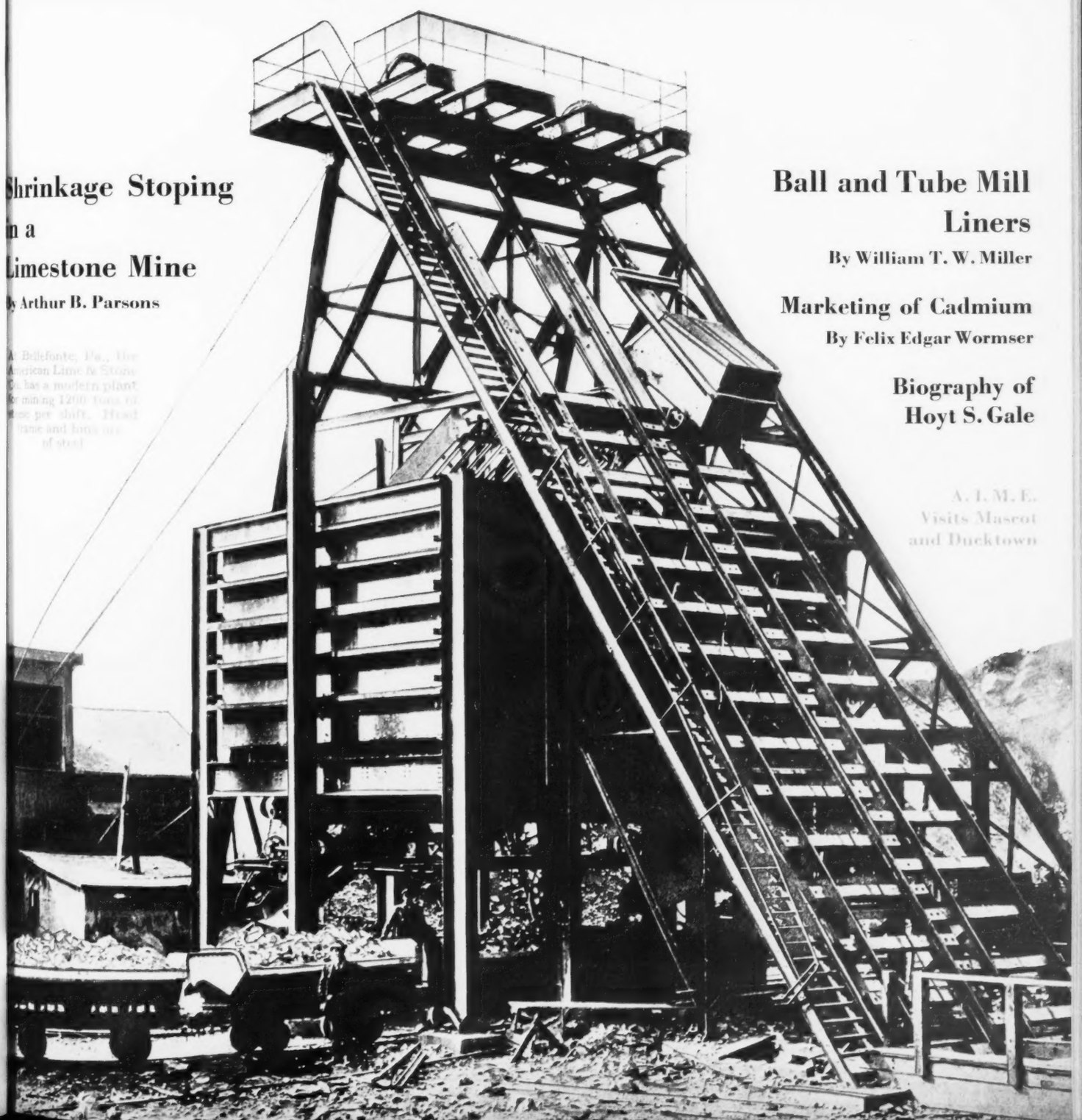


Shrinkage Stoping in a Limestone Mine

By Arthur B. Parsons

At Bellefonte, Pa., the American Lime & Stone Co. has a modern plant for mining 1200 tons of stone per shift. Head frame and bins are of steel.

Ball and Tube Mill Liners

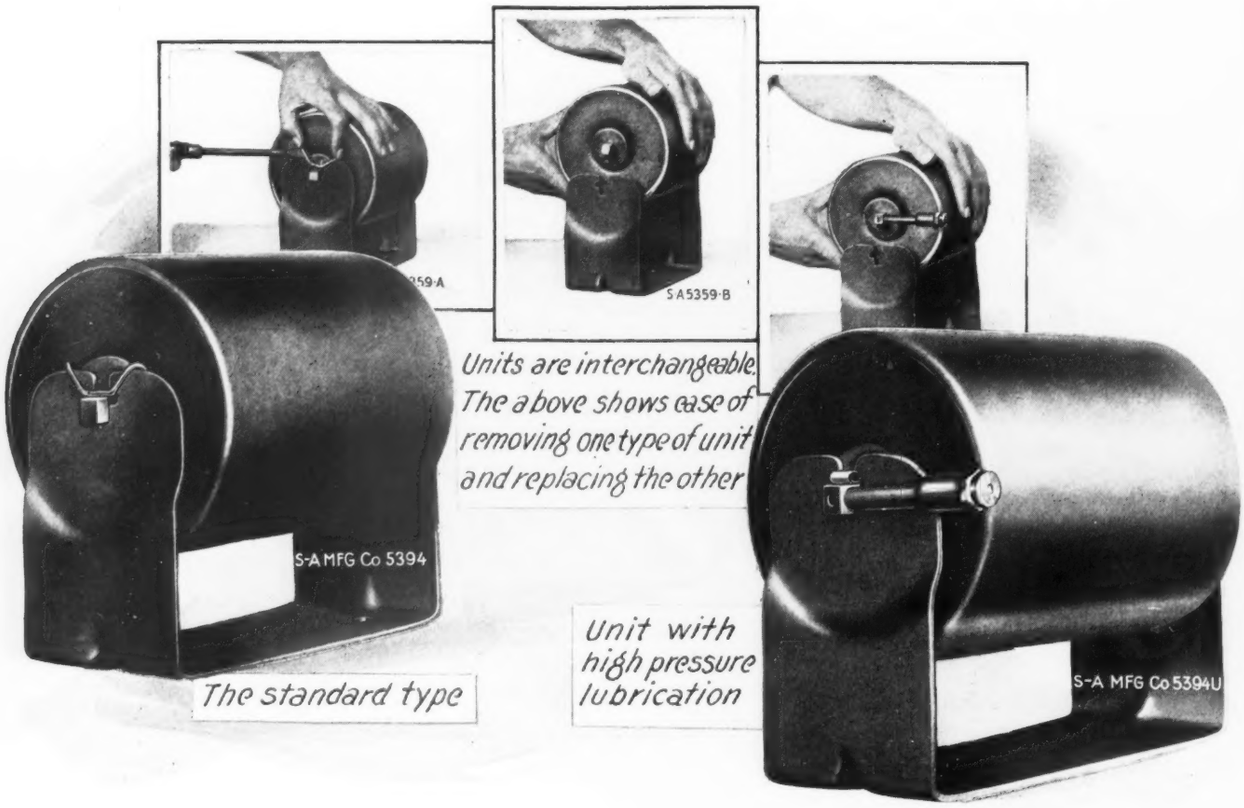
By William T. W. Miller

Marketing of Cadmium

By Felix Edgar Wormser

Biography of Hoyt S. Gale

A. I. M. E. Visits Mascot and Ducktown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ENGINEERING AND
MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

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The Division of Knowledge

THERE ARE TWO EXTREMES or types of thought concerning human organization—the individualistic and the socialistic—one demanding the maximum of individual independence and initiative, the other the maximum of aggregate or mass action. Civilizations begin in individualism and end in high social organization; then finally through the weakening of individuality thus brought about, they weaken and are overthrown by invasions of foreign races, or by the development of rebellious individualism within their own ranks.

A hundred years ago, in the United States the farmer was independent of one and all. He and his family raised and made their own food, fuel and clothing. They were their own grocers, butchers, weavers, masons, carpenters, and tailors. A hundred years ago the engineer was a universal engineer. What the knowledge of the times could accomplish in engineering work, the one man could do. Even in 1866, when *Engineering and Mining Journal* was established, other engineering than mining was represented in the new publication.

The mining engineer differentiated gradually from engineers in general: and his knowledge comprised, among many other things, mining, the mechanics of operations and machinery, metallurgy of all sorts, geology, mining economics, and the rest. The universal and independent mining engineer is now as obsolete as the universal and independent farmer, although there may be a few relics in both branches of industry who do not know it.

Specialization is not the spirit, but the law of the day. Economists who preach crop diversification for farmers—a return to old methods—are ignoring this compelling law, which is an economic one. Knowledge has expanded enormously and swiftly in the last hundred years; the brain, following the slow process of evolution, has expanded little. The human device for meeting this condition has been the division of knowledge, so that the possession of it and the application of it becomes more and more a group matter and less and less an individual possibility. Not only are there no complete farmers, physicians, or lawyers, not only no complete mining engineers, any more; but there are no complete metallurgists, no complete geologists, even no complete mining geologists. The subdivision of work grows more complex yearly. Yearly the specialist narrows his field, in order that he may dig more deeply; and thus the number of specialists in a given field of knowledge is continuously increased. The editing of a journal like the *Engineering and Mining Journal-Press* brings out the multitudinous separate divisions and separate workers, who now work side by side, but with small interest or knowledge in each other's work, in the conduct of the now complex mining industries.

It is useless to swell up, and imagine that we contradict this law. It is useless to pretend to each other that we do. And the general rule is to acknowledge it frankly. What we do not so clearly recognize always, perhaps, is that the tendency is one that is increasing with astonishing celerity. The future will show, apparently, as great movement in this direction as in the past. Civilization will only be carried on and developed further by group action, which must of course be definitely organized. In this it is seen that the growing number of societies and organizations of all sorts—the splitting of societies into narrower societies—obeys a compelling law, and has not been even optional with us.

Whether our ideals are individualistic or socialistic, we must perforce become more and more a part of groups, of organizations. Through this alone can we make whatever individual force or contribution we may have effective. Even Mussolini, that great individualist, was individualist and effective only as the organizer of a group. The multitudinous committee and similar paraphernalia which characterize our days are therefore seen to have a logical and compelling reason for existence. We must resign ourselves to complex societies. We must work in groups. The knowledge of any one of us these days would be pitiful and useless if not flanked and extended by the knowledge of many fellow men.

Individualism must, however, assert itself in these groups. The social organization must be into democracies, not gangs. Our hope of individual progress lies in each one having a voice. Hence, societies that are organized so that members do not have a full voice, so that they have not an effective vote in all matters, equal to that of anyone else, are pernicious and dangerous. We must reconcile ourselves to the increasing importance and complexity of societies and similar organizations: but we must insist on the maximum play and scope and suffrage of individuals therein. Thereby we will make the best of the grave predicament into which the stampede of advancing knowledge has forced the limited human brains; thereby we shall perhaps avoid the dangers of wooden and unthinking social organizations, whose results nature shows us in the bees and the ants.

Gold and Mercury

SOME MONTHS AFTER we chronicled the claim that gold had been produced from mercury by a German (Miethe) in Berlin, the matter receives the editorial attention of that most reliable daily, the *New York Evening Post*. By this time, however, the story has changed, so that the *Post* has it that the alchemist is a Japanese doctor in Tokio.

The German doctor has the right of way. As we have pointed out editorially, however, no proof has been offered as to the fact of such a transmutation; and a very proper attitude of mind is to be exceedingly skeptical. Even though gold has been obtained in this way, the cost is probably out of all reason.

Difficulties of a Great Non-metallic Mining Industry

ONE OF THE MOST REMARKABLE DECLINES ever recorded in the price fluctuation of a raw material is the drop that has occurred in the market value of asbestos since the war. In 1918 and 1919 the best grade of crude asbestos from Quebec, Crude No. 1, sold at prices ranging from $2,000 to $3,000 per ton. In fact, the mineral was so valuable then that considerable "high-grading" of the precious long-fibered asbestos took place. At a dollar per pound and over this might have been expected. Today the same quality of crude asbestos is selling—with difficulty—for $300 per ton, roughly one-tenth of the peak price. When compared with what has happened to asbestos, the post-war depression in copper and zinc is relatively mild. Copper, which sold for more than 30c. per lb. at its crest, and zinc, which sold for over 20c. during the war period, would be selling for 3c. and 2c., respectively, if the decline in the price of these metals had been so severe as that of asbestos. We offer this comparison to the copper and zinc producers as a crumb of comfort, on the ground that it is always consoling in a degree to reflect that someone else is worse off than oneself.

The aftermath of a period of phenomenally high price in the asbestos industry was even more disastrous in its effect upon the welfare of the asbestos-mining industry than upon the copper- and zinc-mining industries. Naturally, with asbestos worth more than a dollar per pound and consumers clamoring for it, production was stimulated to an unusual degree. New plants arose, new pits were dug, new enterprises launched. Not alone did this occur in Quebec, where the bulk of the world's asbestos originates, but also in Rhodesia, where new and promising prospects received just the price encouragement necessary to lift them from the stage of likely prospects and small mines to large-scale low-cost producers. The competition of South African "blue" and other grades of asbestos has been one of the principal reasons for the sharp and steady decrease of asbestos prices for the last five years. Coupled with the overextension of the industry in Quebec, the effect of the competition has been ruinous to several producers in Canada. Some of them closed down, presumably with sufficient financial strength to survive a period of inactivity; other companies became reorganized. The reader will recall the difficulties of the Bennett-Martin company, which, a few months ago, was declared insolvent, and has recently been taken over by another corporation. None of the producers is particularly prosperous just now.

Unfortunately for the Quebec producers, they cannot fall back upon that expedient of which industry in the United States is so fond—the tariff. Canadian asbestos is mainly consumed in the United States, where it encounters Rhodesian competition. A tariff on the importation of asbestos into the United States would apply to both products equally. One of these days the same forces which caused the decline in the price of asbestos will correct the unsatisfactory condition of the industry. Already an amalgamation of various smaller units has been accomplished, and should this movement extend further it may bring about a controlled rate of production. Furthermore, the low price for which asbestos is selling should increase the outlet for this valuable mineral.

Developing Prospects

THERE IS FREQUENT COMPLAINT that mining companies will consider an investment only in proven mines; and that they will not consider prospects. We must reflect, however, that, if this is true, there must be a sound economic reason for it; and this reason must be that mining companies have found that, by and large, it is not a paying business to try to make mines out of prospects. That some of the prospects at present begging capital could be transformed into mines is certain. Which ones, is the question. Who knows? The answer to this will depend on the advance of applied geology and no less on the caliber of the geological diagnostician. All prospects do not develop into mines, as all who are acquainted with ore deposits know.

As a matter of fact, many mining companies have spent and are spending much capital on prospects. Occasionally they succeed. The willingness to venture is strongest in the vicinity of proven mines. The Deputy Minister of Mines in Ontario, T. W. Gibson, reports such a condition in his province, declaring that financiers in England are willing to venture. He states that "No reasonable prospect of a good gold mine will go begging. The possibilities of this country have been placed fully before the monied men over there, and I have several promises that syndicates will act as soon as likely prospects are brought to their attention."

Whatever pays will be continued. Whatever policy is found in the long run to result in financial loss will be laid aside as a business policy.

For the Benefit of All Parties

THE CO-OPERATION of a great mine with an organization of farmers, so that both farming and mining profit handsomely, is illustrated by the deal by which the Inspiration Consolidated mine of Miami, in Arizona, secured power by a contract with the Salt River Valley Water Users' Association of that state. About 6,000 farmers of Salt River Valley are the stockholders of the Water Users' Association, farming about 240,000 acres of irrigated land. Their association produces not only water but electrical power, approximately 25,000 hp. at present, the power plants being located at the Roosevelt Dam and favorable spots along the water canals. Twenty-eight miles below the Roosevelt Dam, the Mormon Flat Dam was begun a year ago, which will enable a continuous operation of the power plant at the Roosevelt Dam. None of this power, however, is available for the use of the Inspiration, since it is already contracted for. Therefore a new dam has been begun—the Horse Mesa Dam, seventeen miles below the Roosevelt Dam, and this will make additional power, for which the Inspiration Consolidated has contracted for a minimum worth $565,000 annually, for the next fifteen years.

M. E. Bemis, commenting on this arrangement, in the *California Cultivator*, says:

"Pretty soft for the farmers? Well it does look good all right, to have free water, debts paid, and the value of their farms increased because of the partnership which makes every owner of an acre of land a share holder in the association, and then within a few years at most to have electricity available at a very moderate cost. Farmers have their troubles and none of them are rolling in riches, but this is one thing that I do not hear any complaints about."

Hard Money

TO THE UNINITIATED it might seem that almost any reasonably hard metal would do for coins, but the wide adoption of copper, nickel, silver, and gold for this purpose, to the virtual exclusion of other metals, is well founded on the superior durability of these metals. Aluminum has been used to some extent, particularly since the World War, but some of the experiments with new metals and alloys for this purpose have not been successful. Just recently it has been reported, for example, that Bulgarian coins made of aluminum are crumbling to dust, and it is feared that the entire issue of 100,000,000 leva may disintegrate. It is thought that too much zinc may be present in the aluminum. As desirable as hard money may be, it would be preferable to have one's wealth in paper money rather than in metallic disks which, through oxidation or other deteriorative process, would soon become indistinguishable as money.

Copper has been widely adopted for coins of the smallest denomination, but pure copper is too soft; it is alloyed, in the United States cent, for example, with 5 per cent of tin and zinc. It wears well and is distinctive, owing to its color. For coins of the next higher denomination, the use of nickel or nickel alloy is common. Pure nickel is sufficiently hard and well adapted to coinage purposes, and it is being increasingly so used. The Canadian five-cent pieces are a good example; they lack the reddish tinge of the United States five-cent piece, which is only one-fourth nickel, the remainder being copper. Almost every country has silver coins in free circulation, the purest being the United States coins, if we are not mistaken, which are 90 per cent silver. Others range down to 50 per cent silver, which is the standard for Great Britain at present. Gold coins are in circulation in the United States and Mexico, but have never been widely accepted for ordinary retail transactions, owing to the great discrepancy between their value and size. In most foreign countries, gold continues to be too scarce to allow it to be freely used as money.

Formerly, gold was freely circulated in the West; now it is rarely seen, though obtainable at any bank. The Westerners' fondness for silver dollars continues, however; on a recent trip eastward we noted Omaha as the border line; in New York they are a curiosity.

Happy Without Oil

THE SIAMESE GOVERNMENT recently explored for oil, and employed the best engineers and geologists for the purpose. The report was unfavorable, and was delivered with the usual lack of enthusiasm which characterizes engineers who turn a property down, miners' legends to the contrary notwithstanding. They stoically awaited the expected coolness on the part of their governmental employers; but instead there was warmth and the smiles of satisfaction. The government felt relieved that Siam did not promise oil, for then the chance was good for no meddling and intrigue by European governments.

The boundaries of British territory and those of French territory lie next to Siam. Enough said. Without oil, Siam may develop in peace, consolidate her independence, educate her children, enlarge her culture. It does not aspire to add to what Kipling euphemistically called "The White Man's Burden."

Metallurgists Speed Up Transatlantic Cables

NOT LONG AGO in these columns we mentioned a new nickel-iron alloy, known as Permalloy, which has unusual magnetic properties. Thin strips of this metal are wound around the newest transatlantic cable connecting New York with the Azores Islands, and the speed of transmission has thus been raised from the old average of 150 to 300 letters per minute, to 1,500 letters per minute; that is, one cable so constructed will do the work of five to ten cables of the old copper-rubber-steel combination.

This is only one of the ways that nickel is finding an outlet since the war demand subsided. Faced with an almost entire absence of demand three or four years ago, the nickel producers have gone to great lengths in research to find new uses for their product and have developed the manufacture of malleable nickel and several useful alloys.

Permalloy, which contains 80 per cent of nickel and 20 per cent of iron, seems to be proving one of the most useful of the products of the research engineers. The saving to the oceanic cable companies alone will be enormous and should assist them greatly in meeting the competition from radio.

Arsenopyrite in Nova Scotia

NOVA SCOTIA has started to produce arsenical ores, 1,000 tons having been shipped to Antwerp, Belgium, recently, the purchaser being the British Government.

Nova Scotia contains many gold-quartz veins, which have produced considerable gold; but on account of the spotted occurrence of the gold in the quartz, the production never became large and steady—a characteristic of all gold-quartz veins along the Atlantic seaboard of North America. Arsenopyrite veins, usually more or less auriferous, are close genetic relatives of gold-quartz veins: and these occur in considerable quantity in Nova Scotia, as well as in the Appalachian gold fields of the United States.

Arsenic is one of the mineral elements of which it is not likely that there will be, in North America, any immediate stringency. As a byproduct of smelter ores of mixed types, it is abundant; to a relatively slight extent it occurs in certain mines as the sulphide realgar; and to a very considerable degree as arsenopyrite (mispickel) in veins like those of Nova Scotia. Such mispickel veins will be found in many regions where gold has been sought or mined.

Impartial Testimony

LOUIS J. HOROWITZ, a contractor in New York City, builder of hundreds of millions of dollars' worth of skyscrapers and other structures, is quoted as saying:

"In construction where labor is the big element of cost, and where difference of material is slight, there could be no greater folly than using inferior material, to wear out in five or a dozen years, when copper would last practically forever."

Copper producers and the *Journal-Press* have said substantially the same thing many times, but neither they nor we, whose business directly or indirectly is mining, will carry as much conviction to the average architect as will Mr. Horowitz, whose business is building.

Geologists of Note

Hoyt Stoddard Gale

THE STUDY OF NATURE, whether it be the crust of the earth or the flora and scenic beauty that find accentuated expression in many places, is conducive to an even disposition of mind and a philosophy of life that looks upon civilization's activities in an especially charitable way. Geologists get a great deal out of life for this reason. Hoyt Stoddard Gale is one of these favored geologists who has specialized more particularly in economic geology. He was born at Cleveland, Ohio, and earned his A.B. degree at Harvard in 1900. At the same university he received his S.B. degree in geology two years later. Soon thereafter he married Miss Almira Miller at Cambridge, Mass. Gale was appointed geologic aid with the U. S. Geological Survey in 1903, and subsequently was advanced to assistant geologist and geologist. For eight years, from 1912 to 1920, he was geologist in charge of the section of non-metalliferous deposits under C. W. Hayes, Waldemar Lindgren, and David White. During this period he specialized in the application of stratigraphic and structural geology to deposits of economic importance, particularly coal, oil, and phosphates, and later potash and nitrate deposits. His investigations took him into many of the Western states. In 1916, he visited Peru and Chile for private interests and studied potash and nitrate deposits. The next year he was appointed special agent in the War Department and conducted investigations in Guatemala relating to mineral supplies needed for the prosecution of the war. Other studies were made in direct co-operation with the War Department. In 1918, supposed nitrate deposits on the west coast of Mexico were investigated. The next year, as special representative of the Interior Department, he made a trip to Europe and studied the potash mines in Alsace and Spain as well as in Germany. In 1920, Gale embarked upon private work to a large extent. He made a six-months' trip in the interior of South America, visiting northwestern Argentina and eastern Bolivia in the interest of oil-field exploration. He returned to California and spent the next year in consulting practice that included a special study of borax and oil geology. For two years he occupied the position of chief geologist for the South American Gulf Oil Co., a subsidiary of the Gulf Oil Corporation, and visited various countries in South and Central America. Succeeding this engagement, Gale opened his office in Los Angeles as consulting geologist, where he has since interested himself chiefly in oil work. He has devoted a great deal of attention to non-metallic minerals, specializing particularly in the economic geology of petroleum in the western part of the United States and in South and Central America, and in phosphate, potash, salt, borax, natural soda, nitrates, magnesite, and other minerals. His interest in borax is still retained and he plans to collate his extensive data on this subject and to publish the results. Gale has made numerous contributions to the bulletins and publications of the U. S. Geological Survey, among which are various reports on the geology of the coal and oil fields in northwestern Colorado and Wyoming, the phosphate deposits of Idaho, Wyoming, Utah, and Montana, alunite in Utah, and general reports on nitrate, potash, and other non-metallic mineral deposits. In connection with the Geological Survey's campaign of exploration for potash, the study of the late Quaternary history of the Owens, Searles, and Panamint lake basins and the publications relating thereto are of special interest. He contributed to the volume on "Political and Commercial Geology" and has been generous in making known the results of his investigations through the columns of the *Mining Journal-Press*. In addition, he improved a field instrument for geological work which is widely used and which is known as the Gale alidade.

HOYT STODDARD GALE

Gale is a member of the Washington Academy of Sciences, the Geological Society of Washington, the Society of Economic Geologists, the American Association of Petroleum Geologists, the American Association for the Advancement of Science, the American Institute of Mining and Metallurgical Engineers, and the Cosmos Club, of Washington, D. C.

Mining Limestone with Shrinkage Stopes

Underground Operations Displace Open-Cut Mining at Bellefonte, Pa.

By Arthur B. Parsons
Assistant Editor

CLEANER AND BETTER STONE; more dependable and adequate all-year output; more complete recovery of good stone; and lower cost per ton of product are the principal advantages gained by the American Lime & Stone Co. when it began underground mining operations in succession to the open-cut methods used at its limestone properties at Bellefonte, Pa., until about two years ago. When underground work was first started, wide breast stopes were driven with a pilot drift at the top, followed by underhand mining with two additional benches in a stope 30 ft. high. About a year ago, however, an ordinary shrinkage-stope method was adopted, and it is being worked most successfully.

General view of the American Lime & Stone Co.'s plant at Bellefonte, Pa.

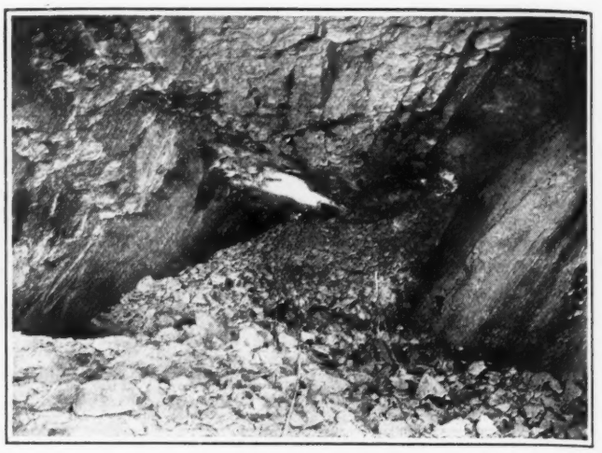
The breast stoping was abandoned, first, because of the danger to the workers of occasional rock falls from the high roof. Second, because shrinkage stoping would make it possible to increase the rate of production to the capacity of the hoisting equipment, which is about 200 tons per hour. There were only eight available headings under the breast stope method, each of which yielded only about 100 tons per day. Since it is possible to open for shrinking as many blocks in each direction from the shaft as desirable, the capacity virtually is limited only by the ability to dispose of the output. And, third the change was made because it was believed that the cost of shrinkage mining would be lower. Results have verified this belief.

Although there undoubtedly is a definite tendency toward the wider introduction of underground methods in the mining of limestone and other low-priced products, the question of the relative economy of such methods as compared with open-cut work can be answered only by a thorough analysis of the conditions at a particular property. A brief description of the deposit, of the conditions prevailing, and of the methods used at Bellefonte should afford the miner of limestone by open-cut methods elsewhere at least a little light on his own problem—if he sees one; or it may show him that he has a problem, if he does not already know it.

The bed or beds of "good" stone—so called because the silica content is low and the calcium carbonate content very high—are about 75 ft. thick and lie between conformable beds of inferior limestone. The dip at the outcrop is about 52 deg.; this increases slowly, and below the 315 ft. point on the incline the angle becomes about 63 deg. This steep inclination of the beds is obviously a disadvantage in open-cut mining; but, on the other hand, it is a favorable factor in mining by underground methods. Another favorable circumstance is the solidity of the lime stratum and the absence of serious blockiness. Naturally, in mining a product of such low per-ton value, timbering is out of the question. Fortunately, the ground at Bellefonte requires no support.

The American Lime & Stone Co. owns or controls about 10 miles along the strike of the Bellefonte ledge (as the "good" stone is known), and has for years operated a series of open cuts along the outcrop. Batteries of shaft kilns were situated at various points convenient to the quarries. In 1921 the company erected a large plant consisting of a rotary kiln and a lime hydrating plant at Bellefonte, and it was essential that

Mounted machines drill 12- and 14-ft. holes in the stopes



The end of a shrinkage stope, showing the footwall

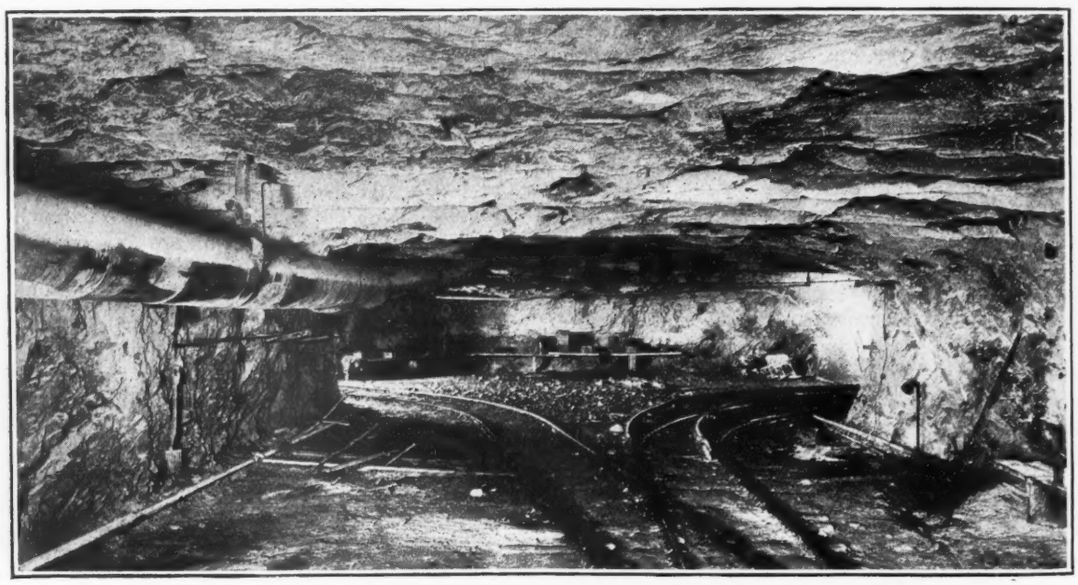
this plant be assured of a constant supply of high-grade stone. In addition, the company operates some of its shaft kilns, and it ships large quantities of unburned stone to industrial users. Stone for open-hearth steel furnaces must contain less than 1½ per cent silica, and the pieces range from 6 to 12 in. in size. Flux for blast furnaces is smaller in size, 3 to 8 in., and the maximum allowable silica content is 4½ per cent. Stone for road construction, for concrete aggregate, or macadam is sized in grades ranging from ½ in. up to 3½ in. The undersize material can be used in the rotary kiln and also is marketed for other purposes. Its value and salability are greatly increased by the underground mining methods, for reasons that I shall point out.

A brief discussion of the various advantages of the method now employed will serve to bring out the peculiar features of the situation at Bellefonte.

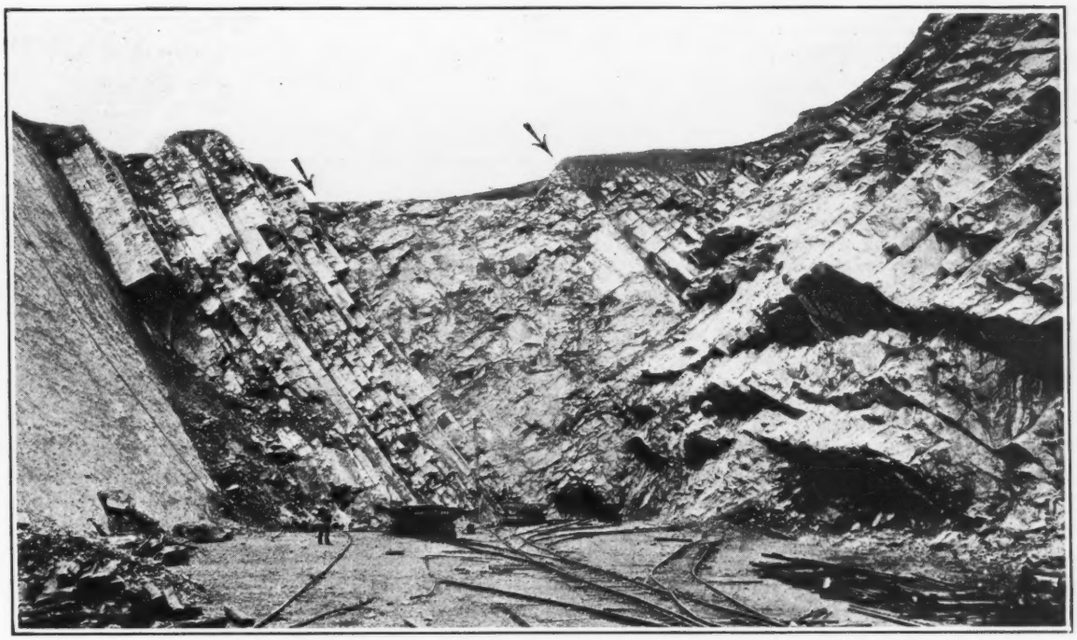
1. *Cleanness of the Product*—Contamination of the open-cut product arises from two sources: (a) The unavoidable breaking and mingling of some of the inferior stone from the adjacent strata; and (b) the admixture of clay or sand from the overburden. Stripping never is perfect, and rain and wind always tend to mix fine contaminating material. Another tendency in wet weather is for the coarse pieces of "good" lime to become coated with a layer of mud, which necessarily gets into the final products. All of these difficulties are obviated by the substitution of underground work. Only about 58 ft. on the footwall of the 72 ft. of high-grade limestone is being mined, so that the siliceous limestone is excluded entirely. Immediately above the good ledge is a weak blocky stratum that would be likely to fall if given a chance. On the other hand a distinct cleavage against a solid footwall is easy to break to and no contamination results. This is particularly true with the present shrinkage stoping, the use of which removes the possibility of any slabbing from the back.

2. *Dependability of Output*—In the winter weather open-cut operations are subject to interference and delay. Transportation from distant quarries is sometimes a serious problem. Night work in open cuts is also conducted under difficulties. The underground operations may be conducted on two shifts, and output is entirely independent of weather conditions.

3. *Complete Recovery of the Stone*—In open-cut operation advance is made in the direction of the "strike" of the bed, the start being made where a ravine cuts



A crosscut to the "ore." Drifts run in each direction. Note the absence of timber and the ventilating pipe

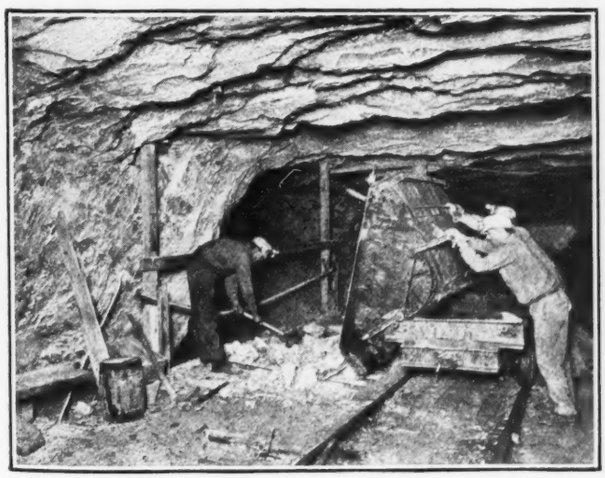


Old open-cut workings, showing limitations of production from "good" strata indicated by arrows

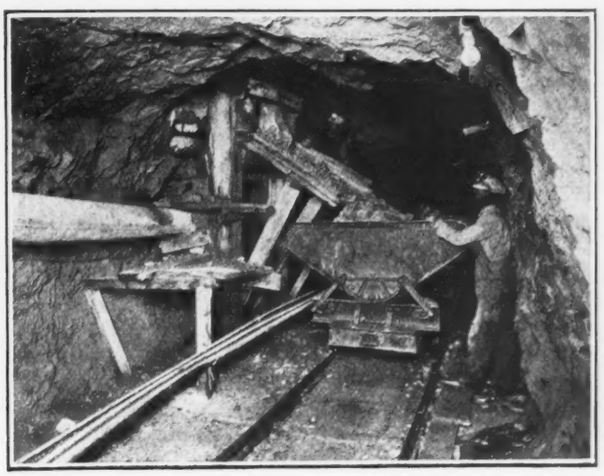
Only two tracks can approach the face at the floor of the cut. The deeper the level the more serious this difficulty becomes

the ledge to expose a face. Obviously, the wall of the excavation near the hanging wall of the bed cannot overhang; at best it can be only vertical. There must also be a face sufficiently wide at the floor of the cut to permit several tracks to approach it, so that a reasonable output can be obtained. These requirements limit the height of the cuts, which range from 70 ft. to 120 ft. Likewise, it is clear that a "toe" included between the vertical wall of the cut and the hanging wall of the stratum must be allowed to remain unmined. The underground method allows the removal of this toe, and imposes virtually no restrictions as to the depth to which operations may be carried. Certain pillars must, of course, be left, but most of these ultimately may be removed.

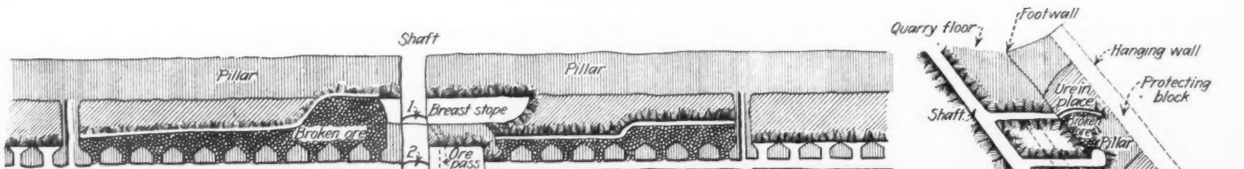
4. *Lower Costs per Ton*—The breaking of rock in an open cut is, generally speaking, a much less expensive operation than underground. Churn drills and heavy blasts are more economical than light air drills and many small shots. And yet in this particular enterprise several factors favor underground operations: (a) The opening of an open cut from a ravine entails a great deal of deadwork. The thinness of the bed to be mined, as has been explained, makes the production from a given quarry small, and consequently the cost per ton is large. (b) The thinness and dip of the vein make the capacity for daily output comparatively small from a given face. And yet there must be the full complement of foreman, enginemen, switchmen, and dumpers at each of the many faces that must be operating to afford an adequate supply of stone. This increases the operating cost per ton of rock. (c) The laying and maintenance of long outdoor tracks to connect the outlying open cuts with the new plant would be an important item of cost. (d) Stripping 12 ft. of clay and 6 ft. of boulders, which is the average overburden on the deposit, would be an element of cost that is eliminated entirely in underground work.



Dumping stone from the stopes into the orepass to the skip-loading bin

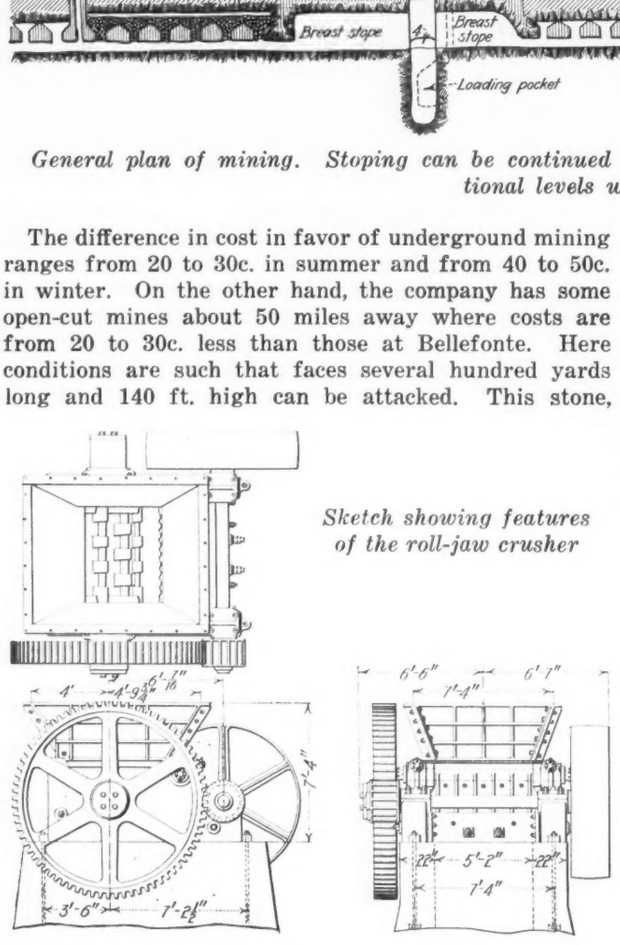


Drawing from the stopes. Storage-battery locomotives draw the cars to the station



General plan of mining. Stoping can be continued indefinitely in both lateral directions. Later, additional levels will be opened

The difference in cost in favor of underground mining ranges from 20 to 30c. in summer and from 40 to 50c. in winter. On the other hand, the company has some open-cut mines about 50 miles away where costs are from 20 to 30c. less than those at Bellefonte. Here conditions are such that faces several hundred yards long and 140 ft. high can be attacked. This stone, however, is of inferior grade and cannot take the place of the high-grade Bellefonte stone for many purposes.



Sketch showing features of the roll-jaw crusher

It is clear that, although the company controls an immense span along the strike of the Bellefonte bed, the supply of stone cheaply minable by open-cut methods would ultimately be exhausted, so that conditions clearly pointed to the advisability of underground operations.

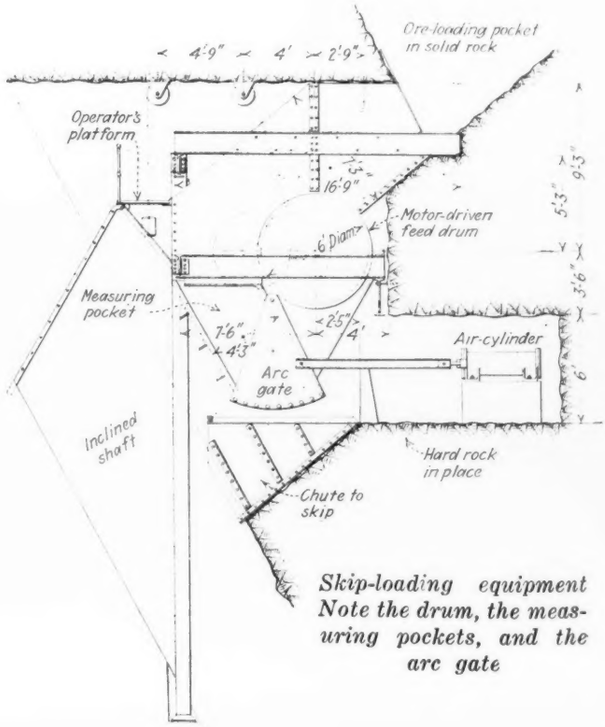
Four-compartment Inclined Shaft

The mine is now opened by an inclined shaft 391 ft. deep paralleling the Bellefonte ledge, but lying about 85 ft. from it in the footwall. The shaft is 8x24 ft., and has two skip compartments, a cageway, and a ladder compartment. A concrete collar is provided, but virtually no timber is required. The original plan provided for four working levels, and crosscuts 24 ft. wide were run to the ledge on each, as shown on the accompanying sketch. A main inclined raise with branches to each of the crosscuts was driven to serve as an ore pass to permit all loading into the skips to be done at the bottom level. As shrinkage stoping is to be done only from the second and fourth levels, the intermediates are to be abandoned.

There is nothing unusual about the mining method. Solomon Koski, the mine captain under E. L. Morris, superintendent, is from the iron mines of Michigan. He brought with him the design of the chute which has an ample mouth, 6½ ft. square. Holes in the stopes are 12 to 14 ft. deep, drilled horizontally to break by slabbing from the back. The company seems to have shown good judgment in obtaining the services of a practical mine foreman when it ventured into a field that was new to the old staff. The accompanying sketch shows the plan of operation and incidentally the portions of the "orebody" that were mined by the breast-stope method.

S. M. Shallcross, acting general manager, to whom I am indebted for most of the information in this article, has divided mining into three operations: (a) Development, which includes driving drifts and raises, raising the chutes and connecting them, and building chutes; (b) shrinkage mining, including the slabbing and drawing the excess stone (the volumetric ratio of ore in place to ore broken is 6:10), and (c) drawing the stope.

With the work properly organized these operations should be in exact balance and each should produce the



Skip-loading equipment Note the drum, the measuring pockets, and the arc gate

following tonnages on the basis of 1,000 tons per day: (a), 150 tons; (b), 350 tons, and (c), 500 tons. Unless this ratio is maintained something is wrong, and steps are taken at once to correct the difficulty.

Drilling is done with wet machines exclusively. Waugh turbros with independent rotation are used in development; and either Waugh clipper or Ingersoll-Rand D.C.R. W23 mounted drills are used in the stopes. Hollow Swedish steel, 1 in. hexagonal and 1½ in. round, are used respectively in stoping and drifting.

Armstrong No. 12 Shuveloders, operated by air, are used for loading in the drifts. Side-dump steel cars of two-ton capacity are supplied by the Easton Car & Construction Co. They were pushed by hand at the start, but a Mancha storage-battery locomotive has been installed on the second level and another will be placed on the fourth as the haul becomes longer. This is a six-ton locomotive equipped with 48 Exide Iron-Clad cells. Other mine equipment includes a Worthington triplex pump, a De Laval two-stage centrifugal, and a Sirocco blower for ventilation, all driven by G.E. motors.

Solomon Koski, mine captain, and E. L. Morris, mine superintendent

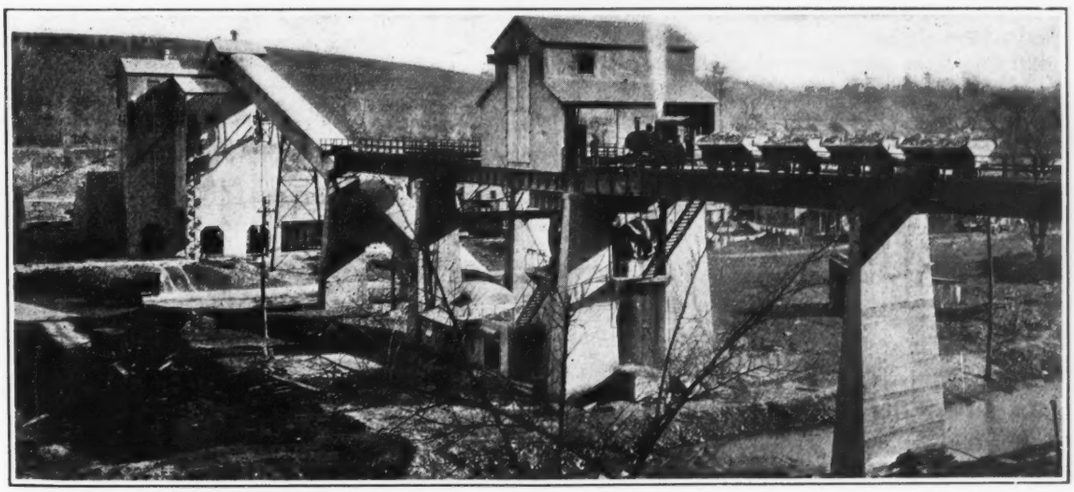
A particularly effective installation is the skip-loading equipment at the bottom of the shaft. This was especially built by the Traylor Engineering & Manufacturing Co. As indicated in the accompanying sketch, a gear-driven drum, 6 ft. in diameter, feeds the ore into a measuring hopper, which is emptied almost instantaneously into the skip by means of an undercut arc gate actuated by an air cylinder. Air is supplied by an Ingersoll-Rand Imperial compressor of 1,000 cu.ft. capacity, and the five-ton balanced skips are raised by an Ottumwa Iron Works electric hoist.

Beneath the steel headframe is a 300-ton steel storage bin into which the skips dump. The stone is drawn into six-ton side-dump cars through air-controlled basket feeders in the bottom of the bin. As a means of minimizing wear on the cars, sheet-iron chutes, transferable and mounted on rails, are provided to break the fall of the stone. Trains of rock are hauled to the crushing plant by means of ten-ton Vulcan saddleback locomotives, one of which is seen in the accompanying illustration.

The primary breaker is a 36x60 in. roll-jaw crusher made by the McLanahan-Stone Machine Co. This machine can handle run-of-mine rock, dumped directly from the cars; it has large capacity, and if need be can handle sticky or mud-coated material. The teeth on the roll operate to force the material through the machine. This, of course, is not a factor in this particular insfallation. Driven by a 250-hp. motor, it has a capacity of 350 tons per hour from run-of-mine to 8 in. A 7½ Gates gyratory made by the Allis-Chalmers Co. breaks the oversize from the roll crusher to 5 in. maximum, in which condition the stone is conveyed by a special 36-in. Manhattan belt conveyor inclined at 22 deg. to the top of the screening plant.

The subsequent operations of the company are beyond the scope of this article. It is significant, however, that the huge rotary kiln, that makes caustic lime of grades ranging from powder up to eggsize, and the modern hydrating plant, are under the constant supervision of a technical staff. Two chemical laboratories are provided, and each step is under close and accurate chemical control.

Quality is the keynote of all operations; the first operation is underground mining to insure the cleanest possible stone as the essential raw material for high-grade finished products.

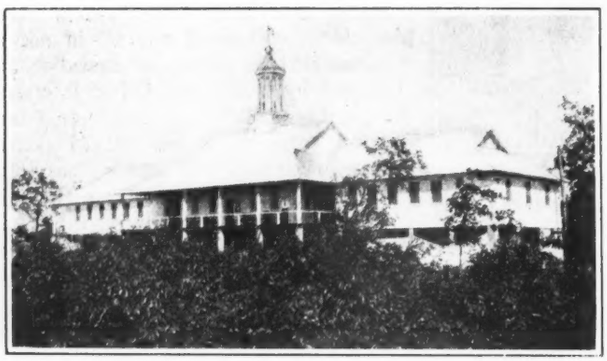


Coarse-crushing and screening plants of the American Lime & Stone Co. The buildings gunited inside and out

M.I.T. Summer Mining Camp at Dover Closes for Season

ON SEPT. 30 the ten-weeks' session of the Massachusetts Institute of Technology summer mining camp near Dover, N. J., came to an end. The class this year included seventeen students, three fewer than that of 1923. Eight weeks of the course were devoted to mine surveying under the direction of W. C. Eberhard and three assistants, Messrs. Murdock, Green, and Mitch; one week to mining practice under W. Spencer Hutchinson and E. E. Bugbee; and one week to field geology under Waldemar Lindgren and W. F. Jones.

The summer session last year was the first to be held in the new camp, the buildings of which were then incomplete, so that the students were housed in tents. The administrative building, with its two wings, shown in the accompanying illustration, was finished this year except for a cupola, which is to be added and which



Administrative building of M.I.T. Summer Mining Camp near Dover, N. J. The wings will be used for instruction and other purposes. The cupola shown sketched in is yet to be constructed

has been sketched in by the architect on the photograph shown. One wing of this building was used temporarily during the summer as a dormitory. It is intended, however, to erect three or more buildings of five rooms each, similar in type to the cubicle which is shown in another photograph. This cubicle has only two rooms, each of which accommodates two persons. Thus, with three five-room cubicles the camp will be able to accommodate thirty students.

The equipment of the camp as well as the plans of the

Students, instructors, and mine officials at Richard mine

A two-room cubicle accommodating four men

Institute regarding it were set forth at some length in the *Mining Journal-Press* of Oct. 20, 1923. Not far from the camp are the mines and mills of various steel and iron companies, so that the students are enabled to study actual mining and milling practice at close range.

Ontario's Mineral Production January-June, 1924

Returns received by the Ontario Department of Mines from the mines, smelters, and refining works of the province for the six months ended June 30, 1924, are tabulated below. Comparative figures are given for the corresponding period in 1923. Tons throughout are short tons of 2,000 pounds.

Product	Quantity (Six Months) 1924	Quantity (Six Months) 1923	Value (Six Months) 1924	Value (Six Months) 1923
Metallic				
Gold, oz.	571,248	418,497	$11,810,060	$8,648,938
Silver, oz.	5,008,256	4,938,364	3,262,100	3,280,209
Platinum metals, oz	3,507	85	337,820	7,109
Copper sulphate, lb.	2,189		112	
Copper, metallic, lb.	9,552,274	6,083,601	1,225,750	967,054
Copper in matte (*a*), tons	3,996	2,835	719,318	567,005
Nickel in matte (*a*), tons	6,052	4,594	1,815,570	2,296,818
Iron ore (*b*), tons	43	6,486	110	22,579
Iron, pig (*c*), tons	5,636	6,537	90,977	176,499
Cobalt, metallic, lb.	121,549	139,746	287,946	374,425
Cobalt oxide, lb.	170,308	242,604	424,170	475,681
Nickel oxide, lb.	5,770,622	4,607,827	899,694	854,596
Nickel-cobalt compounds and residues, tons	493	133	338,017	152,852
Nickel, metallic, lb.	15,775,618	10,308,418	3,271,635	1,986,421
Bismuth, lb.	12,683		30,614	
Lead, pig, lb.	2,525,487	1,784,749	185,942	120,694
Total metallic			$24,699,835	$19,930,696
Non-metallic				
Actinolite, tons	50	55	$625	$605
Arsenic, lb.	1,726,666	2,387,168	173,372	288,586
Feldspar, tons	7,335	7,446	58,510	40,811
Fluorspar, tons	1	61	22	531
Graphite, tons	637	545	38,061	31,588
Gypsum, tons	43,238	47,948	208,523	219,656
Iron pyrites, tons	5,311	6,538	21,129	24,047
Mica, tons	531	721	82,683	27,661
Mineral water			8,170	2,500
Natural gas, M. cu.ft.	4,484,650	4,388,000	2,690,790	2,457,280
Petroleum, bbl.	81,569	78,299	184,520	216,015
Quartz, tons	45,928	41,275	80,032	94,008
Salt, tons	96,466	96,207	732,734	854,119
Talc, tons	4,986	4,535	62,770	58,550
Total non-metallic			$4,341,941	$4,316,047
Clay products and structural materials			$8,956,000	$10,966,000
Grand total			$37,997,776	$35,212,746

(*a*) Copper and nickel exported in the form of matte valued at 10c. and 25c per pound, respectively, in 1923, and at 9c. and 15c. in 1924.
(*b*) Iron-ore figures in the table include only shipments to points other than Ontario blast furnaces.
(*c*) Figures in the table represent proportional output and value of pig iron produced from Ontario iron ore. The total output of pig iron was 402,561 tons valued at $6,498,342.

Marketing of Cadmium

A Byproduct of Smelting Operations in Which Competition Is Keen

By Felix Edgar Wormser
Assistant Editor

CADMIUM is a byproduct of certain smelting and chemical manufacturing plants. World resources of the metal are more than enough to supply the somewhat limited demand, and, given the proper price stimulus, production can be increased should the market warrant. Sales of cadmium are generally made in small parcels compared with the ordinary-sized consignments of other non-ferrous metal markets. Producers consider a 100-lb. case of cadmium a minimum lot, but sales are usually concluded for larger amounts. A transaction involving, say, one ton of cadmium in a sale would be considered a large purchase.

Quotations for cadmium are made on a delivered basis uniformly to consumers anywhere in the United States. Owing to the relatively high price per pound of cadmium compared with other base metals, the difference in delivery charges from smelter or warehouse to consumer amounts to only a small fraction of the total unit price and is included in the quotation, regardless of the consumer's location.

One General Form for Cadmium

The market is not controlled by any one producer, and prices are determined by competitive conditions in the world market. Prices generally move slowly, however. Of late, competition has been so severe that prices have moved almost as rapidly as those of other non-ferrous metals.

Cadmium is molded at the smelter or refinery into pencils or rods ⅜ in. in diameter and 12 in. long, a convenient form for handling. These pencils give a peculiar "crackle" when bent. It has sometimes been cast into 50 and 100 lb. slabs for shipment to brass manufacturers, but this form is obsolete now. The pencils seem satisfactory for nearly all purposes. Cadmium wire is now also available to consumers, and has been drawn to meet the requirements of metal vaporizing and spraying machines. No. 13 B. & S. gage is the size demanded. It is used in conjunction with copper, antimonial lead, and other kinds of wire to coat plaster casts, statuary, and other objects, with cadmium and other metals—the Schoop process.

Cadmium rods are packed in stout wooden boxes, each carrying 100 lb. Consignments may be shipped by local freight or express. Producers generally keep a supply of cadmium in various sections of the United States to meet the demand quickly from any particular district.

The following smelting companies make a commercial grade of cadmium:

American Smelting & Refining Co., Denver, Colo.; sales office, 120 Broadway, New York
U. S. Smelting, Refining & Mining Co., Midvale, Utah; sales office, 120 Broadway, New York
Anaconda Copper Mining Co., Great Falls, Mont.; sales office, 25 Broadway, New York
New Jersey Zinc Co., Palmerton, Pa.; sales office, 160 Front St., New York
Consolidated Mining & Smelting Co. of Canada, Ltd., Trail, B. C.; sales office, Drummond Building, Montreal

Also the following chemical and manufacturing companies:

Grasselli Chemical Co., Cleveland, Ohio
Krebs Pigment & Chemical Co., Newport, Del.
Midland Chemical Co., Argo, Ill.
Mineral Refining & Chemical Corporation, Carondelet, Mo.

The smelters listed above may handle cadmium-bearing material, mainly baghouse dust and residues, from affiliated plants. None of these companies use brand marks on their output, the reputation of the producer being sufficient guarantee for the quality of each shipment.

The principal sources of cadmium are blue powder from zinc smelting, baghouse fumes from lead smelting (the cadmium is derived from the zinc ores associated with the lead), sludge from the tanks used in the electrolytic production of zinc, and residues from lithopone plants. It is produced electrolytically. Cadmium is present in practically all zinc ores at an average ratio of 1:200, according to Liebenthal.[1]

The standard purity of commercial cadmium in both the United States and Europe is 99.5 per cent. Nearly all of it, however, runs well above this figure—as high as 99.9 per cent at times. The chief impurities are copper, lead, and zinc, which, in the aggregate, do not total more than 0.25 per cent. As a good proportion of the cadmium used is alloyed with copper, lead, and zinc, the impurities are not deleterious. Manufacturers are well satisfied with the high quality of the product being sold by producers in this country, and there is seldom any disagreement over impurities. No penalties or premiums on grades are allowed.

Some Applications of Cadmium

The use of cadmium is expanding, but so is its production. In fact, the volume of production is a step ahead of consumption, so that prices of cadmium metal have declined from over $1.20 per lb. two years ago to 60c. in 1924. The lower price for the metal may stimulate consumption, however, and bring its own corrective. It will also deter new prospective producers from entering the field. Cadmium is used in making the alloys with low melting points found in automatic sprinkling systems. These fusible alloys contain from 1 to 15 per cent of cadmium. A copper-cadmium alloy is also being manufactured. It is said that 1.1 per cent of cadmium is used and that at a sacrifice of 10 per cent in conductivity the strength of copper wire is increased 50 per cent. This permits poles supporting copper wires to be placed further apart. In Europe, the use of cadmium-copper wire is being pushed, as it is in the United States, in installations where strength is desirable. Some dental amalgams contain cadmium. Cliché metal, used for stereotype plates, contains about 22.5 per cent cadmium. Solders have been developed in which cadmium is used as a substitute for tin. Now that the price of cadmium is lower than it has been for twelve years, and not very much greater than the price of tin, it would not be surprising if cadmium were partly substituted for tin. Proportionally less cadmium than tin is needed in solders. Cadmium is also used for electroplating, by means of the udylite process. Metal articles

[1] "Mineral Resources of the U. S."

are plated with cadmium by this method and then heated at a moderate temperature to alloy the cadmium with the metal coated. The application of this process industrially seems to be growing. Hardware, automobile parts, and wire products have been coated with cadmium satisfactorily.

Cadmium pigments, notably the sulphide, are used by paint manufacturers and glass manufacturers. The pigments vary in shade from a beautiful golden yellow through orange to a reddish brown. Being impervious to the action of the elements, cadmium paint finds some application in painting railroad coaches. Several of the western railroads use this brilliant cadmium paint in decorating their passenger rolling stock.

The business of producing cadmium is becoming more and more competitive with new producers entering the field. In the early stages of production in the United States—the Grasselli Chemical Co. was the first company to make the commercial product, in 1907—German competition was the bugaboo of the infant industry. Upper Silesian zinc production then provided most of the byproduct cadmium needed to satisfy world requirements. The war eliminated German competition for the time being. Tasmania is now the principal competitor of the United States. A large zinc-producing company, Electrolytic Zinc, Ltd., at Risdon, Tasmania, has begun to place a good grade of cadmium on the market. This cadmium is shipped mainly to European consumers. Production of cadmium in Tasmania is now estimated at a rate of 150 to 200 tons per year. The output of cadmium in the United States is about 70 to 75 tons per year. The following table, taken from the mineral resources tables of the U. S. Geological Survey, shows the growth of cadmium production in the United States and the average annual price of the product:

Metallic Cadmium and Cadmium Sulphide Produced in the United States, 1906-1922

Year	Metallic Cadmium — Pounds	Metallic Cadmium — Average Value	Cadmium Sulphide — Pounds	Cadmium Sulphide — Average Value
1906	300	$1.00	(a)	....
1907	14,000	1.025	(a)	....
1908	8,000	.75	(a)	....
1909	5,300	.525	(a)	....
1910	4,700	.55	(a)	....
1911	26,152	.67	2,392	$0.70
1912	52,508	.76	8,998	.71
1913	54,198	.77	17,302	.70
1914	(b) 91,409	.89	22,723	.89
1915	91,415	1.19	10,624	1.13
1916	135,212	1.56	22,176	1.26
1917	207,408	1.47	50,169	1.41
1918	127,164	1.48	51,702	1.36
1919	99,939	1.22	31,197	1.20
1920	129,283	1.17	32,133	1.16
1921	68,501	.98	65,446	1.09
1922	(b) 131,590	1.09	134,774	1.13
	1,247,079	.....	449,636	.....

(a) No production.
(b) Exclusive of cadmium in residues sold for export.

United States Produced 310 Tons of Asbestos in 1923

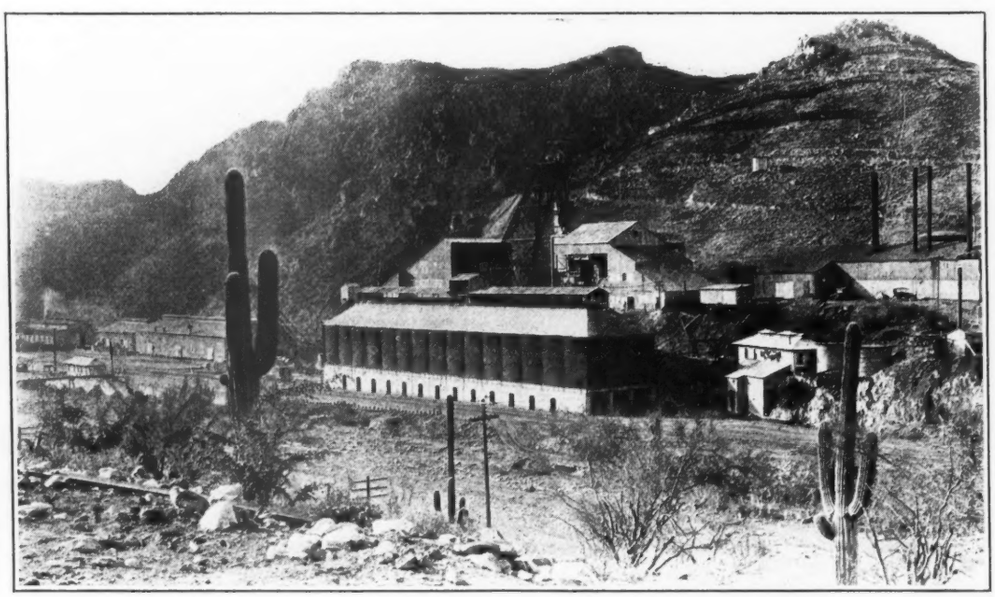
The U. S. Geological Survey reports that the total quantity of asbestos sold by producers in 1923 was 310 tons, valued at $24,826. Although these figures are much larger than those for 1922, the industry was far from being in a normal condition in 1923; indeed, it had come almost to a complete standstill. In the following table the output in 1923 is compared with that in the three preceding years. The industry was most prosperous in 1920, when the output of crude chrysotile was the largest yet made by United States producers.

Domestic Asbestos Sold in the United States, 1920-1923

Year	Chrysotile — Tons	Chrysotile — Value	Amphibole — Tons	Amphibole — Value	Total — Tons	Total — Value
1920	1,245	$661,907	403	$16,324	1,648	$678,231
1921	438	313,268	393	23,700	831	336,968
1922	25	3,320	42	6,800	67	10,120
1923	212	20,533	98	4,293	310	24,826

All the chrysotile variety of asbestos sold in 1923 was mined in Arizona and California; the amphibole variety was mined in Georgia and Maryland. Arizona produced 69 per cent of the total quantity of chrysotile asbestos sold in 1923.

Picturesque Arizona—in the Ray District



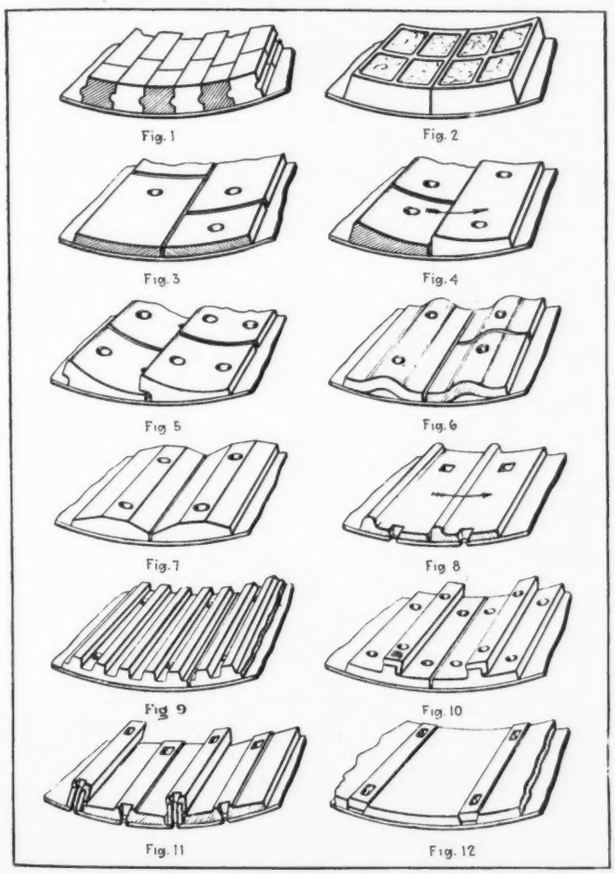
Main shaft and bins, Ray Consolidated Copper Co.

Ball- and Tube-mill Liners

Recent Development Has Brought Out Many Designs Which Help to Increase Grinding Efficiency and Prolong Effective Life of the Steel

By William T. W. Miller
Sheffield, England

IN ITS ORIGINAL CONCEPTION the tube mill was a very simple machine used almost exclusively for fine grinding with a relatively fine feed. Latterly the ball tube mill with stepped liners has encroached on the field originally occupied by intermediate crushers, and in shape and proportions the machine has changed considerably from its prototype. Looking back



over twenty-five years in the development of both tube and ball mills, it is interesting and instructive to follow changes in the liners to make them more durable under the increasingly arduous conditions or to increase the grinding efficiency of the mill. It is possible by study and experiment to modify the shape of the liners in such a way that wear is practically equalized and the amount of metal discarded when the lining is worn out is reduced to the absolute minimum. The design of the liners has also an important bearing on the time occupied in effecting renewals and repairs, and this feature should be of serious interest to those trying to obtain the utmost economy of operation.

In the early days of the tube mill, flint pebbles were largely used as the grinding media, and the lining of the tube was also made of silica in either natural or artificial blocks. The natural rock-silica took the form of small squared blocks, which were usually cemented in position, but sometimes artificial silex bricks of special interlocking shape as shown in Fig. 1 were laid in courses and grouted in place. The process of relining a mill was both long and expensive, and the design shown in Fig. 2 was evolved to reduce the time lost to a minimum. Cast-iron frames, each forming a segment of the circle and containing four through pockets, were laid on a former-board or templet, and the cavities filled with coarse pieces of rock grouted in with finer stone and cement. By using frames in this way the new lining was prepared some time in advance of the dismantling of the old, and the cemented mass had ample time to become strong and hard. The actual time occupied in replacing the lining was also much reduced. In some industries, such as the pottery trade, where it is desired to avoid contamination of the ground product by fine particles of metal, the silex lining is still in use, but such instances are now exceptional, and the use of steel or iron linings has become the general practice.

Fig. 3 shows the metal lining in its simplest form. The plates are usually about 1 to 1½ in. thick, from 11 to 13 in. wide, and 30 or 36 in. long, secured by two or three bolts with countersunk heads. The back is curved to the radius of the tube and may be recessed slightly to insure bedding on the outer edges of the plate. The circumferential joints should break continuity to neutralize the scouring effect which is particularly destructive in fine wet grinding. Occasionally the plain lining is made up of narrow bars or strips of metal about 2 in. wide, 12 in. long, and 2 in. deep in the middle. These bars are laid close together with their length in the direction of the circumference of the tube, and the bedding surfaces are curved to the radius of the mill. As the ends are dovetailed to the true radial lines, the bars are self-locking, and the lining is made secure by a wedge or key driven into the final joint of each ring of liners. Although it is rather complicated to assemble, a lining of this kind has several advantages. The parts are simple to cast and are not so liable to defects as larger pieces. The bars can be brought close together, so that the joint spaces are negligible. Securing bolts are not necessary and holes in the tube are not required. In a wet mill, holes are a constant source of leakage.

Step Liners Increase Agitation

One of the objections to a metal lining is that the surface becomes smooth under wear and the true cylindrical shape causes the charge to slide to and fro as a mass, with little internal agitation. To remedy this and to increase the percussive action of the balls, the plates are now frequently made thicker at one edge than at the other, as shown in Fig. 4, and the charge is disturbed by the wave formation over which it travels. With a lining of this type the direction of rotation is usually as indicated by the arrow, so that the balls fall from the high edge of one plate to the low edge of the adjacent plate, and a powerful disintegrating action is obtained.

Fig. 5 illustrates a further advance in the design of the stepped plates. This type of construction was

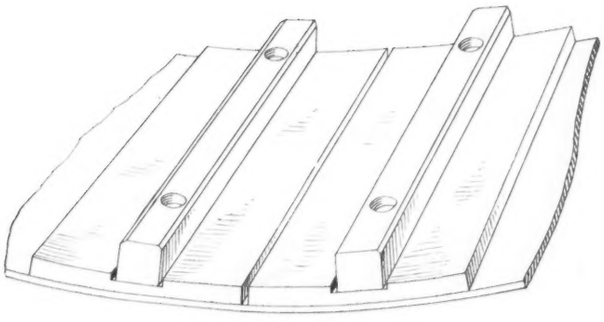


Fig. 11A

introduced in Germany about ten years ago. The plates overlap, so that the longitudinal joints are covered. This permits greater clearance between the sections without risk of damage to the tube and allows for any stretching or elongation of the plates in the circumferential direction under wear.

Another form of lining which gives a corrugated wearing face inside the mill is shown in Fig. 6. The undulating surface tends to promote agitation of the charge, and the symmetrical shape of the liners makes it possible to run the mill in either direction, but the longitudinal joints are not protected as in either of the designs shown in Figs. 4 and 5.

In some of the heavy ball mills built in Europe the plates are made with three flat faces, giving angular depressions between the high points of individual liners, as shown in Fig. 7. Under wear these quickly approximate to the shape shown in Fig. 6, but in their initial form the section is simpler for manufacture as a forging, and this shape is confined largely to forged liners.

Fig. 8 shows a form of ribbed plate construction in which the projection or lifter bar takes a more decided shape. With plates of this type the mill is usually revolved in the direction indicated by the arrow, and the position of the rib on the backward edge of the plate serves as a measure of protection for the longitudinal joint. One objection to this shape of plate is that under heavy wear the rib sometimes gets hammered or drawn over the adjacent plate, making it difficult to remove individual liners when required.

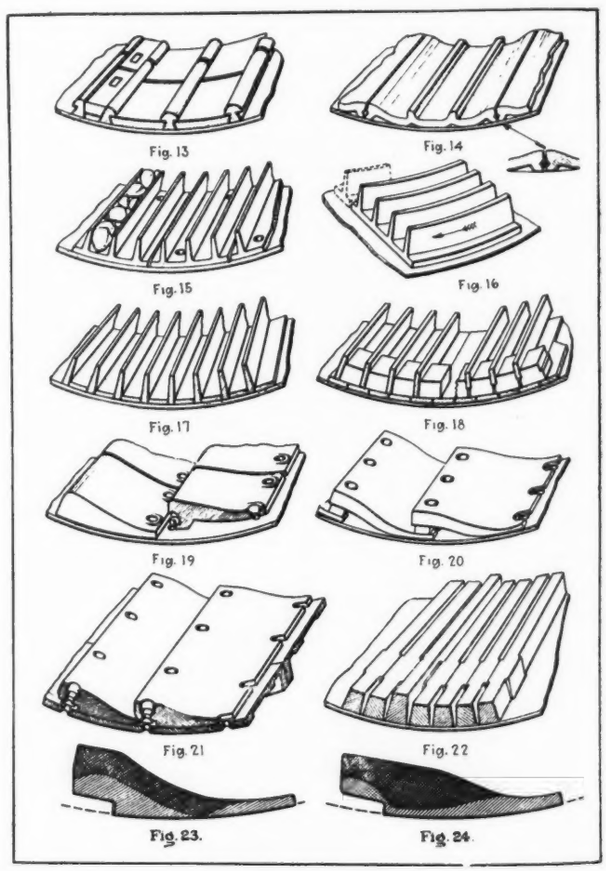
In a few instances the plates are made with a number of projecting longitudinal bars pitched fairly close together. The bars may have either square or rounded tops—preferably the former, as shown in Fig. 9. The material lodging between the riffles produces an irregular or corrugated surface with a better grip on the charge than with a smooth lining. The reduced slip minimizes the wear on the liner, part of the surface wear is taken on the material lying in the spaces, and those who favor this type of liner claim that the consumption of metal lining per ton of ore ground is much less than with the plain smooth liners. These ribbed plates are usually made in the form of oblong sections with their length parallel to the axis of the tube, but some users prefer to have the castings made in long, curved segments with the ribs placed transversely on the plates.

A distinction should be drawn between the liner with close-pitched ribs for holding fine material, and giving a roughened or corrugated surface, and the construction with wide-spaced and more pronounced lifter bars, which elevate a part of the charge and create a true cascading effect. In the former the pitch of the riffles is not of great moment, but in the latter it is found in practice that it is not advisable to have too many lifters in the mill, otherwise the efficiency may be reduced instead of being increased.

It is natural that any form of projecting rib used as a lifter for raising the charge has a tendency to become worn away more quickly than the body of the plate. To remedy this the liners are frequently made with removable wearing strips, as shown in Fig. 10, and the angle bars are cast in some special alloy steel, giving great strength and wear-resisting properties. In the example just mentioned the projecting bar forms part of the plate, being cast in the center of the liner, but in the well-known Komata lining the plates and the lifter bars are independent, as shown in Fig. 11. By this means the bedding-pieces for the renewable angle wearing strips can be made in a cheaper material, such as cast iron.

In yet another design the main wearing plates have a deep recess down the center, and the lifter bar rests in this cavity; the bolts which secure the lifter in position pass through the base plate, so that the bar acts as a clamp to the plate as shown in Fig. 11A.

In most of the foregoing designs the liners are attached to the shell plate of the mill by means of countersunk headed bolts and there is clearance between the plates at both circumferential and longitudinal



joints to allow for irregularities in castings, and deformation under wear.

Another form of attachment is becoming increasingly popular in which the main liners are not bolted direct to the shell plate but are secured by wedge bars bolted to the tube and filling the horizontal joints between adjacent plates as shown in Fig. 12. In a further variation of this principle, covered by British patent, the plates are locked together by means of separate

dovetailed lifter bars, and the complete lining is drawn tight against the inner surface of the tube by a single row of wedge bars, as illustrated in Fig. 13. Both these systems require that the liners and wedge bars should be made with special accuracy, otherwise the lining will not fit the tube correctly. Since the tubes are not always perfectly circular and true to diameter, this is a matter of some difficulty. With the design shown in Fig. 13 there is also the additional disadvantage that the replacement of individual plates is a practical impossibility without dismantling at least one ring of sections.

The Fuller tube-mill lining, shown in Fig. 14, is secured entirely without bolts. The plates are ribbed and waved to give them a powerful lifting surface and are made with V-shaped recesses or grooves in their longitudinal edges so that round locking bars may be inserted along the joint lines to prevent the plates from falling inward when they reach the upper semicircle of rotation. It is obvious that the plates must be carefully made to correspond to the circumference of the tube; also that considerable difficulty must be experienced in withdrawing individual plates should a faulty casting fail early in the life of the lining.

The El Oro Type

When discussing the design illustrated in Fig. 9 mention was made of the fact that with this type of liner the wear was partly taken by the material being ground which lay in the spaces between the bars. In the well-known El Oro lining, shown in Fig. 15, the plates are designed with deep ribs running longitudinally in such a way that the pebbles or pieces of hard rock used as grinding media become wedged into the troughs between the thin taper ribs on the liners and even project above them, so that the wear is taken in large measure on the pebble or rock surface. The spaces between the bars must be arranged to suit the largest size of pebbles used, and it is found in practice that, when correctly designed, all the cavities are automatically kept filled by pebbles or pieces of rock from the charge in the mill.

This special design was the forerunner of several other types based on the same general principle, among which is the Globe and Mueller liner, Fig. 16, which has the troughs arranged in the circumferential direction instead of crosswise. In these plates the ribs are somewhat thicker at their trailing ends, so that each cavity narrows against the direction of revolution and the pebbles are firmly wedged between the bars by the rotation of the mill. Liners of this type must be correctly placed to suit the direction of rotation of the tube.

Another variety of the same species is the Osborne lining, shown in Fig. 17. This follows closely on the original "El Oro" plan except that the longitudinal troughs are made up of parallel and wedge-shaped bars of rolled section steel. The flat bars form the bases, and the taper bars, which form the sides of the troughs, are secured in position by iron wedges, they usually being made of a length approximately equal to the internal length of the mill, so that the renewable end-liners may assist in holding them in place.

With full-length bars it is found that, in a tube of any considerable length, the wear is greatest near the feed end of the mill, and the bars have therefore to be changed round end for end after a period approximating to half their life. Sometimes three short bars are used instead of single bars full length of the mill; when this is done each series of bars is secured independently, so that those near the head end may be changed more frequently without dismantling the whole of the lining. As no bolts are used for securing the bars, there is none of the leakage which is so difficult to avoid in a wet mill with bolted liners.

In the Osborne lining the radial bars have to be discarded when they have become so reduced by wear that the depth of the trough is insufficient to retain the pebbles in position. This means that half of the bar must be scrapped. The arrangement shown in Fig. 18, covered by White-Schmidt patents, has been devised to overcome this defect. The tube is first lined with flat bars wedged or cemented in position, and on this base the radial bars are laid with spacer blocks between them. When the bars are partly worn, the depth of the trough can be restored by rebuilding the lining, using a new set of spacer blocks with projecting edges forming grooves or seatings in which the bars may be set at a greater distance from the periphery of the tube. If desired, the bars can be made in three sections varying in depth, using deep bars near the inlet of the mill and shallower bars close to the outlet end, making a composite lining of approximately equal life throughout.

The foregoing remarks have, in the main, been confined to the liners used in long tube mills; that is, mills in which the length is considerably greater than the diameter. There is a class of grinding mill, usually made to work with 4 in. or 5 in. diameter balls, in which the width or length of the mill is less than the diameter, liners of special types being fitted in these mills. The well-known Kominor or Kominuter mills made under the designs of F. L. Smidth, of Copenhagen, may be instanced as examples of this latter class. In these grinding machines short-stepped liners are used of two distinct patterns. The earlier form is illustrated in Fig. 19. The plates are hollowed out to reduce their weight, and the outer walls along the sides of the liners are extended to bear on the inner circumference of the shell. Each plate is secured by four bolts, two at the thin end with countersunk heads and two with square or tee heads fitting in slotted cores in the thick end of the casting. The plates are arranged in parallel rows, five sections usually making up the width of the lining.

Special Types for Ball Mills

Fig. 20 shows plates of a later pattern, which are reduced to a simple tapering form bent to an ogee curve. The high edge of the liner is raised by inserting a packing piece resting on the thin edge of the adjacent plate; the fastening bolts, with heads countersunk near the thicker part of the plate, pass through round holes in the packing piece and through slots in the thin lower edge of the next plate in the series, thereby reducing the number of bolts for securing the lining to the mill by half. The slot holes in the covered edge of each plate allow for irregularities in castings or forgings and at the same time permit of slight elongation under the hammering action of the balls. In Smidth mills of European manufacture the plates are each secured by two bolts. In those made in America the plates are usually wider and have three fastening bolts. In either case the plates are of such a size that they can be passed through a manhole in one of the end plates without serious disturbance to the mill.

The liners in the Marcy ball mill have a family resemblance to the Kominuter plates, but are usually

made much longer, one-piece liners occupying the full length of the mill. Although they overlap, they are designed so that they bed directly on the tube on the greater portion of their under-surface, as shown in Fig. 21. These long and heavy liners are extremely difficult to replace, necessitating the dismantling of the shell of the mill to get them into position.[1] It is therefore essential that they should be made of the correct thickness and contour to obtain the maximum life before replacement becomes necessary. This type of liner has already passed through a good many changes in section, and there is a decided tendency for each mining company to develop a pattern particularly suited to meet its special conditions. Variations in character of ore, in feed-size and in other factors would appear to produce changes in the degree and locality of the greatest wear on the liners.

Reducing Percentage of Waste Steel

Fig. 23 shows in section by cross-hatched lines the extent of the wear on a Marcy mill plate of normal shape, and Fig. 24 illustrates how the life was increased, at this particular mine, by changing the cross-section of the plate and so reducing the amount of material to be sent to the scrap heap. It has been found advisable to increase the over-all depth of the plate near the feed end of the mill, which is almost invariably the point of greatest wear. One other change has also been made to reduce the scrap weight of the plate, and that is to cut back the thin edge somewhat. It is found that half the usual overlap is sufficient to keep the plate in position. These Marcy mill liners are good examples of the economies which may be made by a careful study of the worn plates and by judicious changes in conformation of later supplies. Before leaving the discussion of these particular plates reference should be made to the two-piece liners which have recently been tried in Mexico. These consist of a wearing face of manganese steel supported on a pillow block of cast iron. (See Fig. 24A.) The outer pair of fixing bolts pass through the wearing plate and pillow block, but the two intermediate bolts are made shorter and have their heads sunk into the cast-iron bedplate.

In the Grondaal ball mills the tube is lined with heavy bars about 110 millimeters deep arranged as shown in Fig. 22. This mill has dished covers, and the ends of the bars are bevelled so that they are secured from falling inward by the overlapping of the end liners, and no bolts are required through the shell plate. In some instances a few of the bars are made of greater depth, so that they project above the main surface of the lining, acting as lifters in the manner previously described.

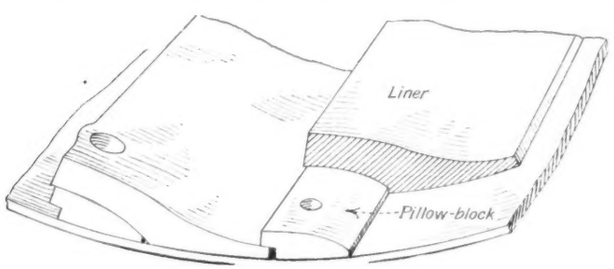
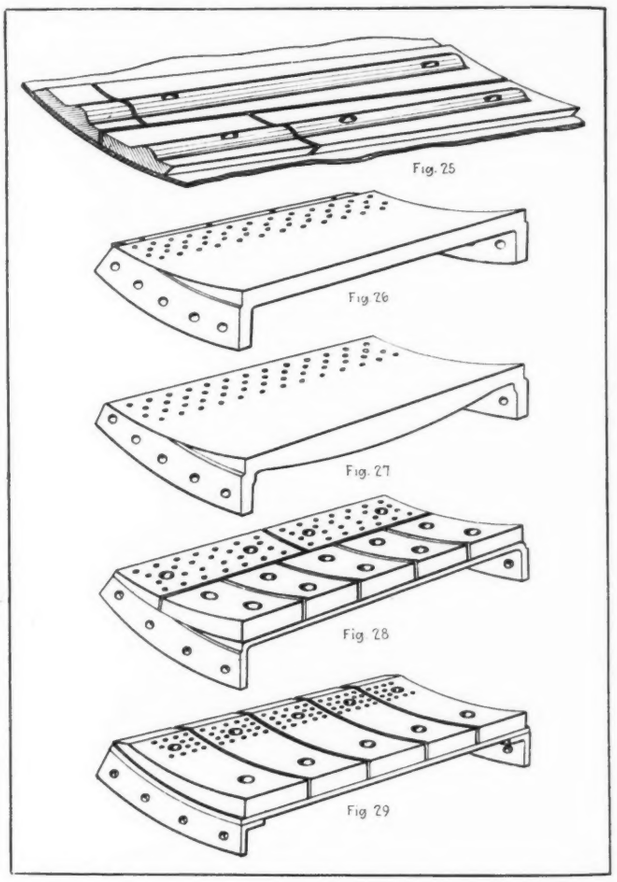


Fig. 24A

In those tube mills which use circular rods as the grinding media the liners have to be made of special shape to give the best results, but as this type of mill is not long past the development stage it would be idle to claim that the best form of liner for this duty has yet been attained.

Fig. 25 shows the liners used in some of the later Marcy rod or roller mills. One long and one short plate make up the total length inside the tube, and the circumferential joints are out of step to break continuity. There are several features of interest in connection with these liners. The plates are usually set on a bed made up of wooden strips about 2 in. thick laid close together inside the shell of the mill. The longitudinal



edges of the plates are beveled in such a way that the joint spaces are not radial to the center of the tube, the joints being inclined at about 30 deg. on each side of the true radial center line. The corrugations formed on the inner surfaces of the plates are not strictly parallel to the axis of the mill, but are inclined at an angle of about 1 in 50 on either side of the center line in the total length of the mill. The object of this helical formation would appear to be to keep the rods crowding as much as possible toward the feed end of the mill, and the inclination should therefore be made to suit the direction of rotation, so as to give a contained angle of less than 90 deg. between the corrugations and the feed-end plates of the mill on the upward or lifting side of the periphery. Sometimes the corrugations or waves extend the full length of the plates; or they may stop short about 6 in. from either end of the mill.

[1]Most of the large mining companies take their mills apart to reline because it is more convenient to do so and they have the crane facilities for changing mills, but we understand that every Marcy can be lined through the manhole if desired. The fewer joints and holes in a lining, the greater the rigidity and the longer the wear.—Editor

The original Krupp ball mills may be taken as typical of a series of short self-screening ball mills fitted with stepped plates and constructed with return openings for the oversize underneath the steps in the lining. In machines of this type the grinding plates form essential parts of the cylinder of the mill, which consist of two flat circular end plates connected by means of a number of solid or composite plates whose internal faces form a series of helical steps in the grinding path of the narrow cylinder. Fig. 26 shows the grinding plates in their original simple form. The part-circular flanges were machined to fit into shallow recesses in the side plates of the mill, and the attachment holes were drilled for turned bolts. These mills usually work with steel balls of relatively large diameter, and often it was found that the grinding action and consequent wear on the plates was less close to the side plates than near the center of the length of the grinding plates. It was therefore found advisable to curve the backs of the plates as shown in Fig. 27, adding the extra metal where it was most needed, and making the longitudinal section as nearly as possible equal in wear value at every point in its length. It is necessary partly to dismantle the mill to renew these solid plates, so some manufacturers favor the composite designs shown in Figs. 28 and 29, as these overcome this objectionable feature and possess other advantages, such as ease of transport and reduction of the material that must be scrapped.

In these designs the back plates are usually shown pressed out of mild steel plate, although sometimes they are made in cast iron. The flanges are machined and drilled as in the solid plates, but the wearing face is divided into a series of renewable liners of such dimensions that they can readily be withdrawn through the manhole. These renewable liners may be arranged in various ways. In the Krupp mills it is customary to divide the screening sections of the plates from the plain grinding portions, the former being made in two divisions and the latter in four or five sections, according to the size of the mill. See Fig. 28. The Lohnert method of subdividing the wearing plates is illustrated in Fig. 29. In all liners of this type care must be taken to see that the screen holes coincide approximately with the clearance holes in the back plate, otherwise the free-screening action so necessary for satisfactory operation of the mill will be impeded and the efficiency lessened.

Manganese Steel a Favorite Material

Liners may be made of cast iron, semi-steel, ordinary steel, chrome steel, and manganese steel. Sometimes with composite liners different materials are used for the component parts.

Hard white iron is used more particularly for the simpler plates in conjunction with either pebbles or small balls as the grinding media. If made extra hard it has a tendency to crack and break under the pounding of heavy balls.

The addition of steel scrap during the melt, making the mixture into semi-steel, will increase the toughness of the plates considerably, but the resulting material is not so hard wearing as chilled white iron.

Castings of ordinary carbon steel have been used for this purpose, but this material is being almost entirely displaced by the more modern alloy steels containing relatively high percentages of chrome or manganese, as it is found that greatly enhanced wearing properties can be obtained for a small increase in the cost of manufacture. The chrome steels used in this way generally contain about 1 per cent of chromium and may be heat-treated in various ways still further to increase the life of the plates.

The remarkable properties of manganese steel have caused it to be adopted largely for the renewable liners for ball and tube mills, and there is little doubt that, if the plates are made of suitable design and proportions, there is no other steel which can compare with it for durability under the severest conditions. It is necessary, however, to point out one or two difficulties in using this particular alloy steel. In the first place, this alloy is subjected to a heating and quenching treatment to obtain the right condition for resisting heavy wear; this water treatment is not effective in penetrating thicknesses greatly exceeding 3 or 3½ in., so it is desirable to avoid excessive variations in thickness. Secondly, this steel remains ductile after treatment and has a tendency to spread or arch under the constant hammering from the balls, so that the plates should be kept of reasonable dimensions and ample clearance allowed for expansion or distortion. Manganese steel has a tendency also to wear with a smoother surface than either cast iron or a straight carbon steel, so that when used for plain liners it does not lift the charge so well, but this difficulty can be largely overcome by a slight change in speed of the mill.

It is frequently difficult to decide on the most economical material to be used under different conditions. Sometimes it pays to use a locally made article of less durability to avoid heavy duty and freight charges, but the reduction of losses in operating time due to shutdowns for renewals will usually more than counterbalance an increase in initial cost. The material which gives good results on one grade of ore will not always give equal results in a similar mill working on another kind of material. A change from dry to wet grinding may also be found to necessitate the use of a different grade of steel.

Designing and Fitting Liners

A few hints on designing and fitting liners may be of service. Bolt heads should be deeply countersunk, otherwise the plates work loose before the full life has been obtained. When using manganese steel, keep the bolts near to the outer edges of the plates, so that if the plates arch under work the bolt heads will not be pulled off. When the liners are newly set to work, tighten all the bolts every few hours until the plates are properly bedded and all bolts are taking an equal share of the work. In wet mills avoid using too many bolts. One of the most serious difficulties in mills grinding wet is to prevent damage to the outer tube by the scouring action which takes place in the joint spaces between the plates. Always break joint in the circumferential direction and use an overhanging or lapped joint where possible.

As previously stated, there is no doubt that a little study of the operating conditions, combined with a close examination of the lining when it has reached the end of its economic life, together with some judicious experimenting in the use of materials of different compositions, will frequently go far to reduce working costs and eliminate troublesome shutdowns due to defective designs or materials.

Useful Operating Ideas

Use of Scrapers in Narrow Veins

By A. S. Winther

United Comstock Mines, Comstock, Nev.

The Yampa orebody in the mine of the Utah Consolidated Mining Co. at Bingham Canyon, Utah, is a contact deposit between a quartzite footwall and limestone hanging wall, dipping 75 to 85 deg. from the horizontal. On the strike it is about 1,500 ft. in length and has been opened up about 1,400 ft. vertically. In width it varies from 2 to 15 ft. The ore is a heavy pyrite with a small amount of chalcopyrite, which has replaced the limestone, showing the bedding planes of the original rock. There is a sharp line of demarkation between ore and footwall, but the mineralization extends several feet into lime hanging wall. In the upper levels—that is, the first 600 ft.—the limestone hanging wall is somewhat broken and fissured and sloughs off in large slabs upon being exposed to the air for a very short time. The footwall is generally good.

The walls in the lower levels are firmer, permitting a larger opening before stulls are required to support them. A different method of mining the ore in this portion of the mine has been developed and is working out satisfactorily. By this method the timber consumption (except for raise sets), the labor of barring and picking down of the packed ore, the difficulty of bringing supplies into an inclined stope, the mining hazard and the discomfort of working on uneven piles of broken ore in the various stopes have been largely or entirely eliminated.

Drifts which have been driven in the vein are timbered with the usual tunnel sets of 10 by 10-in. timbers, spaced 5 ft. center to center. Approximately 60 to 70 ft. in the clear from a pilot raise, another timbered raise, consisting of an ore chute and manway, is started and is carried up as part of the stope. This stope extends from the pilot raise to and including the secondary raise. The longitudinal section, Fig. 1, illustrates the method of stoping and shows stopes in different stages of the mining operation. Mining consists of drilling and blasting a round of holes, about 6 ft. to 6½ ft. deep, the entire length of the stope, breaking all of the ore between walls.

Before any blasting is done, a bulkhead is placed over the sets of the secondary raise. The broken ore is then cleaned off from the bulkhead over the raise sets and additional sets are put in and blocked. The double drum hoist is next elevated to its new position by means of a half-ton triplex block, and clamped to a bar which is packed between the walls. A sheave wheel is fastened to the raise timbers of the pilot raise and the tail rope passed over the sheave. All broken ore is then scraped into the secondary chute. When the ore is cleaned out, the 3 by 12-in. by 8-ft. floor planks, which had been previously placed on the waste filling, are taken up and waste is tapped from the chute of the pilot raise. The same scraper is used to drag the waste from the chute, filling the stope to within about 6.5 to 7 ft. of the back. The waste is leveled off and the plank floor laid again. The planks are placed on the waste filling with one end overlapping so that the scraper in drawing the ore toward the secondary chute will not catch on the ends of the planks. On the return trip the scraper rides over the projecting ends of the planks, due to its circular arc section. This completes the cycle of operations and is repeated.

A scraper 30 in. wide, Fig. 2, with a straight cutting edge on one side and 12-in. teeth on the other side, is used. The heavy pyrite ore breaks into rather coarse boulders with sufficient fines to cause packing, and as a result mucking is difficult. In scraping the ore into the chute it is first necessary to loosen and drag down ore from the top of the pile by using the toothed edge

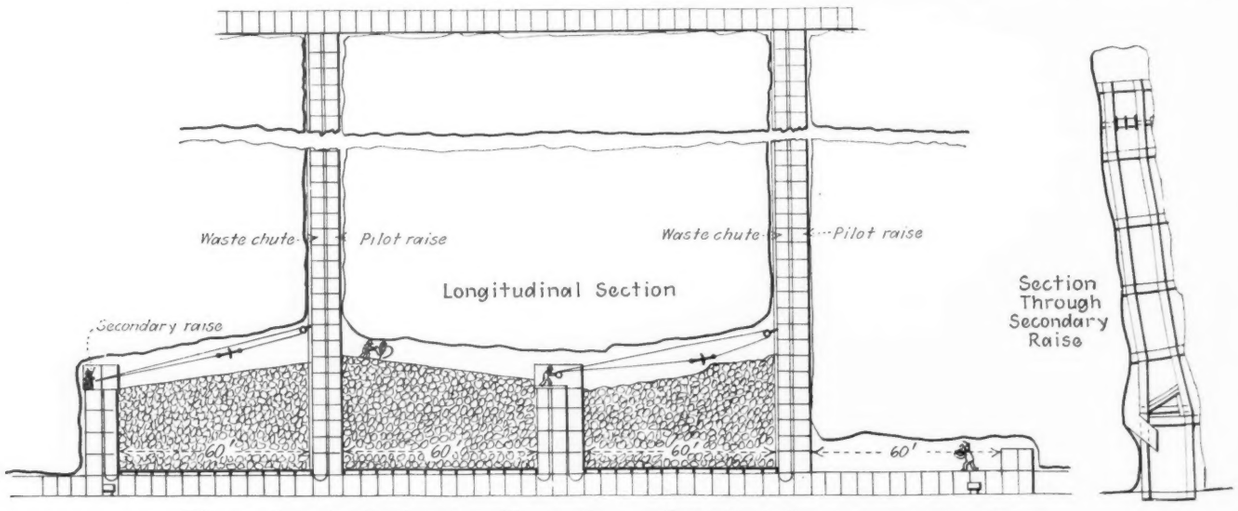


Fig. 1—Longitudinal section illustrating method of stoping, in successive stages, scrapers being used for mucking

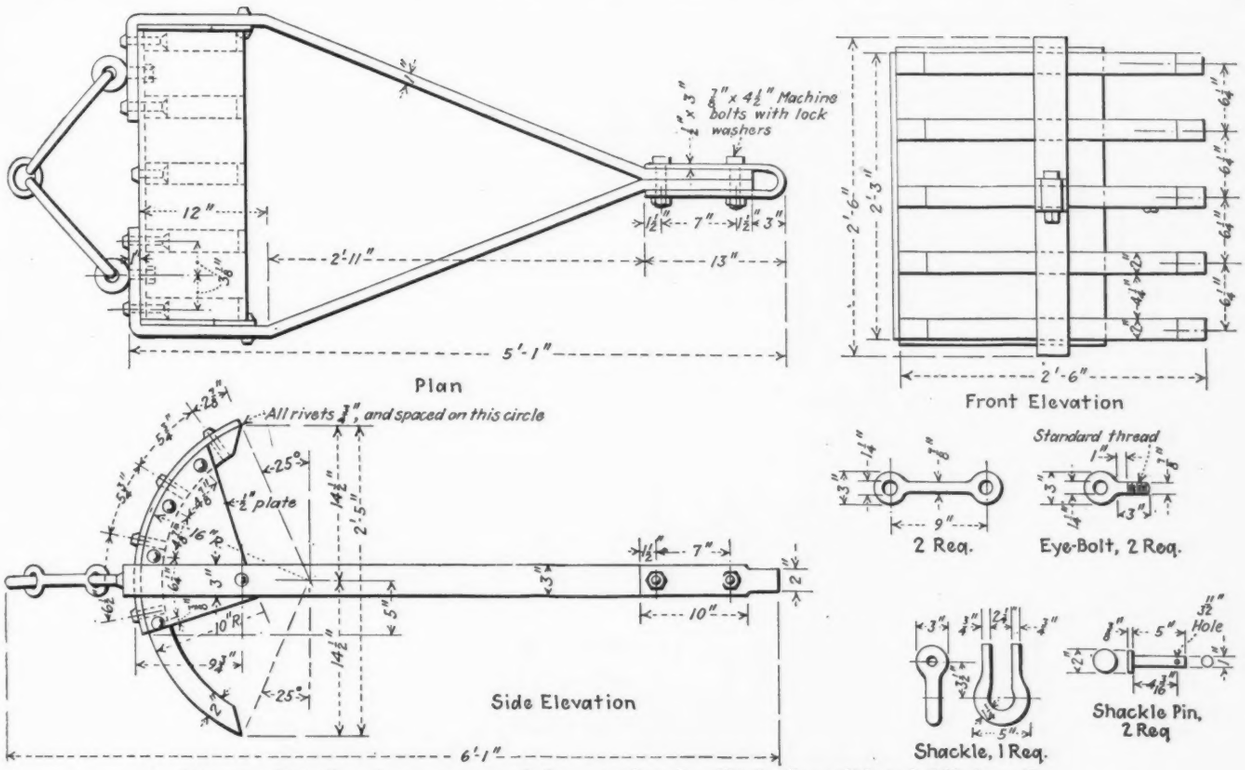


Fig. 2—Details of scraper used for stoping by Utah Consolidated Mining Co.

of the scraper. When several short pulls have been made, the scraper is reversed and the ore is drawn into the chute with the straight cutting edge of the scraper. When the ore packs badly it is necessary to reverse the scraper frequently.

Only two men on a shift are employed in a stope. Three to five shifts are required to drill the entire back of the stope. From one and a half to two shifts are required to scrape the ore from a slice, amounting to about 250 tons in a 5-ft. vein. One cut can be waste-filled and the floors laid in a shift. From two to three shifts are required to clean off the bulkhead over the raise sets, to stand sets, line up chute, raise hoist, and other miscellaneous work. Ordinarily no timbering is required in the stope, but occasionally a stull is put in to hold a bad slab on the hanging wall. The floor planks are used over again, breakage being slight.

As in the rill stoping method, where the vein is less than 6 ft. wide, narrow raises of 8 by 8-in. timbers are used, but where the width is greater than 6 ft., standard square-set timbers are used on 5 by 7-ft. 4-in. centers. The ore is hard to drill and to break. Self-rotating wet-stoping machines are used. In case two pilot raises are spaced 160 to 180 ft. apart, one hoist can operate both ways from the secondary raise, which is advanced with the stope, increasing the tonnage produced by a single hoist. However, pilot raises are expensive to drive and no more are driven than is necessary to provide a sufficient number of working places. When the distance of dragging ore or waste exceeds 75 ft., the efficiency of the method decreases rapidly. This may be probably due to the scraper being retarded by the irregularities of the footwall and hanging wall as the length of the drag is increased. Stopes 100 ft. long have, however, been completed successfully. The hoist is also used to hoist all steel, timbers and supplies into the stope, thus bringing them directly where needed.

Fatigue of Metals

In Bulletin No. 142 of the Engineering Experiment Station of the University of Illinois it is stated that fatigue failure in metals starts at some minute region of high localized stress and that its beginning is a tearing apart of minute pieces of metal. Fatigue failure proceeds by the spreading of the minute fissures thus formed. These fissures may be, but are not necessarily, the sequel of slip along cleavage planes within the crystalline grains of the metal.

Repeated stress produces in a metal both strengthening effects and destructive effects. The strengthening effects are held to include the improvement of bearing between adjacent crystalline grains or other small particles of metal. The destructive effects are believed to consist in the actual tearing apart of particles of the metal, with the consequent formation of minute cracks, which have a tendency to spread.

For wrought ferrous metals the strengthening effects overbalance the destructive effects for cycles of stress below a fairly well-defined limiting stress, but above this limiting stress the destructive effects predominate, and failure occurs if the stress be repeated a sufficient number of times. This limiting stress is the endurance limit of the metal.

The ordinary formulas of mechanics of materials are based on assumptions of homogeneity of material and of regularity of stress distribution throughout the material, and these assumptions imply a much simpler condition than actually exists in metals and other materials of construction. However, these assumptions afford an illustration of stress distribution which may be regarded as accurate in a general, statistical way. Even in the case of progressive failure under repeated stress the ordinary assumptions and formulas of mechanics of materials are found useful.

Discussion

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

Cheap South American Copper

THE EDITOR:

Sir—Referring to the article in your issue of May 17, 1924, "The Bogey of Cheap South American Copper," by Arthur Notman, which I find of unusual interest because of the splendid manner in which this subject is handled, I wish to make an inquiry on the subject of greater output per man in the United States compared with Chile. This subject is brought out in the last part of the article.

The Chilean receives $1.50 per day and produces 100 lb. of copper. The United States workman receives $5 and produces 150 lb. of copper. With copper at 14c., the relative margins are $12.50 and $16 for Chilean and United States conditions. Assuming that the capital costs in the two countries are 4½c. and 3c. per pound of copper respectively, the capital cost per man is the same in both cases—namely, $4.50. Now, in deducting this amount from the gross margin we have

Chilean	United States
$12.50	$16.00
4.50	4.50
$8.00	$11.50

These margins are to cover all other costs than wages, to maintain the man in his work, together with whatever profit is made on his employment. If we convert these margins to cents per pound produced they appear as follows:

$$\frac{\$8.00}{100} = 8\text{c per lb.} \qquad \frac{\$11.50}{150} = 7.66\text{c per lb.}$$

The inference from these figures shows an advantage in favor of the Chilean, whereas the original article sets forth $8 and $13 for the margins for the man-day production, corresponding to 8.0c. and 8.7c. respectively when converted to cents per pound of copper, thus giving the impression that the advantage of 0.7c. lies with the United States producer. H. B. HANLEY.

Rolla, Mo.

THE EDITOR:

Sir—Please accept my appreciation of the opportunity you kindly afford me to comment on the perfectly justified criticism of Mr. Hanley's letter of my article on the "Bogey of Cheap South American Copper" dated May 17, 1924.

Mr. Hanley has pointed out an arithmetical error in my calculation. On the assumed scales of wages this error when corrected puts the balance in favor of the Chilean worker by one-third cent per pound instead of seven-tenth cents per pound in favor of the United States worker. At the time of writing the article I had no authentic figures on the Chilean labor scale and am still somewhat hazy on the subject. Since then, however, a more extended study of the subject has convinced me that the actual capital cost of the two groups of companies, based on returning the investment in twenty years with interest at 5 per cent, shows as follows:

	Earnings per Pound Available for Dividends (Before Depletion)	Capital Cost per Pound (Depletion)	Profit per Pound
North American Group..	4.7c	2.9c	1.8c
South American Group..	5.6c	5.8c	0.2c

These figures will be found in a more recent article on the "Return to Normal of the Copper Industry." It must be noted in compiling the tables that Utah Copper owns 51 per cent of the stock of the Nevada Consolidated. This is necessary to avoid duplication of the assets represented by this ownership. This comparison supports my contention that both the capital cost and the real depreciation cost (not the depreciation charged) are twice as great for the South American group as for the North American.

Making these changes in the table on page 4 of the article referred to by Mr. Hanley we can again attempt to allocate that portion of the difference in outcome chargeable to the respective efficiencies of the Chilean and United States workers. This was what I attempted to do in the example in the later paragraph. Revising this example we have the following:

Output per man per day	Chile 100 Lb. of Copper	United States 150 Lb. of Copper
Value @ 14c per man per day.....	$14.00	$21.00
Wages per man per day.....	2.50	5.00
	$11.50	$16.00
Capital cost per man per day.....	5.80	4.35
Margin to cover other costs and profit (Materials, power, transportation, selling, administration, taxes, etc., and profit.)	$5.70	$11.65

Converting these margins to cents per pound, we have 5.7c. for Chile and 7.7c. for the United States, which checks the first table above, and shows the same 2c. per pound in favor of the United States labor. The figures on the output per man per day are intended to cover all labor employed to put copper in shape for shipment from the smelter or leaching plant and are fairly representative of the companies considered. It seems that while the actual native Chilean mine labor receives about $1.50 gold per day, the more skilled workers, a large proportion of whom are white, receive sufficient to bring the average up to about $2.50 per day, or one-half the money paid to the North American worker.

Of course, the question of capital cost and that of the even more elusive depreciation cost are open to argument. For a time at least while plants are new they may be overlooked in the glamour of large operating profits, but sooner or later they turn up like the bad penny. The sooner they are taken care of the better for the investor. ARTHUR NOTMAN.

New York.

Mechanics of Vein Injection

THE EDITOR:

Sir—So far as I have noted, an outstanding feature of "The Ore Magmas" has been overlooked in the reviews. The operating mining engineer has, as a rule, access to a meager library and seldom does he belong to any of the several societies or associations to which have been or are contributed the theses and discussions on the subject of economic geology. "The Ore Magmas" refers, generously, to this or that theory, outlining its essence and affording at least a mental picture of the point of divergence between the theory and the point under consideration.

Mr. Spurr has presented others' as well as his own arguments. In this way he has placed before the isolated engineer who, perforce, must look to the geology of his ore deposit, much that is not otherwise available to him. Moreover, the style in which the matter is presented induces in the engineer so situated analytical and argumentative consideration of his own problems. Somewhere, possibly in several places, "The Ore Magmas" will suggest establishing a new viewpoint from which to work out the solution of these problems.

In discussing the "intrusive power" (Chapter III), Spurr introduces "for convenience," as he explains, the term, "telluric or bathogenic pressure" (p. 177), as the force through which intrusive magmas and veindikes obtain their power to move and to fracture and penetrate the more superficial envelope of the earth.

Certain mechanical and physical facts are recognized and firmly established as affecting the earth. The average density is known and that of the superficial zone; the latter, within the present range of man's knowledge, is less than the average of the earth. Gravity is acting on this superficial zone, as with unattached masses resting upon its surface, in its effort to maintain equilibrium (isostasy); affording, if not motion, at least static pressure.

Engineering practice takes advantage of the greater mobility of matter, when mingled with a small volume of air or gas under pressure, to move, transport or elevate materials.

SEGREGATED MAGMAS MORE MOBILE

It is generally conceded that processes of segregation and combination in intrusive rocks or mineral complexes involve solids, aqueous solutions, and gases. Are not, as a consequence, the resultant magmas inherently lighter and more mobile than the solid or unsegregated magma from which, for reasons beyond our knowledge, or at best speculative, they are disengaging themselves? Passing from the rock and dike magmas to the ore vein magmas, the concentration of gases in proportion to matter must be greatly increased and thus greatly reduces the specific gravity of the column; and, with the expansive pressure of the gases, increases its mobility. Hence its penetrating power. As resistance diminishes these vein magmas become more mobile and more penetrant; and, if a susceptible formation be encountered, they insidiously disseminate themselves in stringers (as I have observed with a pure chalcopyrite ore, in schist), in bunches, or seemingly isolated segregations, or branch out in many small veins, there to solidify under favorable conditions of temperature. As the end phase of this mechanical progress, in the case of highly mobile ore magmas penetrating a favorable formation, can we not conceive the origin of some of the semi-"disseminated" ore deposits and their shading into "replacement" orebodies?

MECHANICAL EFFECTS ON FORM OF OREBODY

Spurr (pp. 94 and 105) discusses lenticular orebodies, of veins comprised of a succession of lenses, and lenticular occurrences of sulphides, accounting for their form as follows (p. 105):

> "That the phenomenon is the result of the balance of intrusive pressure of the vein magma and the resistant and incrushing pressure of the rock walls; and that the bulging and lenticular shape offers greater resistance, with its arched walls, than do parallel walls."

Let us amplify this by an explanation from another angle. Mobile masses, in nature, tend to assume the spherical form; pressures within a mobile mass are equal in all directions; and resistance equals the pressure opposed. We have the vein magma injecting itself into the formation with sufficient force to induce schisting of the walls (or into a zone schisted by the parent intrusive) and following the plane of least resistance as it cleaves its way toward the surface. Pressure is induced in the walls and resistance set up—less resistance in some areas and more in others. Then we would reason that the tendency toward spherical shape (resulting in the lenticular form) is due to the physical law of equal pressures in all directions; and that such development takes place in those areas where the wall pressures present the least resistance to the "intrusive pressure of the vein magma." Also, that the relief of pressure in the areas of less resistance, and expansion of magma therein, result in the attenuation of the vein magma; or, just as in the areas which are under greater wall resistance, the magma may be entirely excluded.

In closing, I would suggest to the engineer-geologist that he is constantly encountering "studies" on the derivation of his orebody, which escape the occasional visit of the geologist who is deeply interested in every detail. Records and sketches of such "studies" will supply much valuable data on the "Origin of Ore Deposits," through a liberal response to the recent editorial appeal for their description and illustration.

Helena, Mont. L. S. ROPES.

Morality of Soviet Concessions Open to Question

THE EDITOR:

Sir—I read with interest the article "What Soviet Russia Has Done to Mining and What It Now Offers," by Sidney Brooks, in your issue of June 14. From the context it appears that investors are advised to investigate concessions of certain mines now worked by Soviet-controlled "trusts" and formerly owned by Russian or foreign companies. Nothing is said about the morality of receiving the property stolen by the anarchists and criminals at the head of the Soviets; but caution is advised on account of the difficulty of getting adequate security.

In view of your exposures of fraudulent mining promotions, I expected to see some editorial comment on the foolishness of investing money in any concessions given by the Soviet, unless of course the concession is given to its former owner. Perhaps, however, I have missed it, owing to the difficulty of getting all one's papers while in the field. E. D. MCDERMOTT.

Southern Rhodesia.

News of the Week

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

RAIL freight on Michigan copper, 47c. in winter and 38c. in summer, has been reduced voluntarily by the roads to 30c. per ton. Producers are holding out for 25c.

Manipulation by insiders, rather than unfavorable mine conditions, is assigned as the reason for the drop of $1 in Dome shares.

The Federal Trade Commission declares the aluminum tariff and the monopoly of the Aluminum Company of America levy a high tax on consumers.

Tintic Standard interests have merged and will develop a group of properties northwest of Eureka, Utah.

The citizens of Kellogg, Idaho, celebrated the thirty-ninth birthday of the Bunker Hill mine in September.

Early shutting down of the Smuggler-Union mine, at Telluride, Colo., is denied by Robert Livermore, president and general manager.

Operations of the Phelps Dodge Corporation, in Arizona and Mexico, are at approximately 60 per cent of maximum capacity.

American phosphate interests appeal to the government for aid in combating the Franco-German accord on Moroccan phosphate production.

Arrangements are being made whereby the Tonopah Belmont Development Co. will finance the exploration of Jim Butler ground, in Nevada.

The Ahmeek mine of the Calumet & Hecla Consolidated, in Michigan, produced 2,300,000 lb. of copper in September—a new record.

Big Reduction in Rail Rates on Michigan Copper

Roads Voluntarily Cut to 30c.—Mining Companies Want 25c. and Rebates

At the hearing at Lansing, on Oct. 9, the copper carrying railroads of Michigan virtually admitted to the state public utilities commission that copper rates between the Michigan copper district and lower Michigan points were too high. Notice was given voluntarily by the railroads of a reduction to 30c. per 100 lb.

Representatives of the roads appeared in answer to a petition by Calumet & Hecla Consolidated for a revision and reduction of rates. The old rates were 47c. in the winter and 38c. in the summer, when water carriers are in competition with the railroads. The company, in its petition, asked for a year-round reduction to 25c.

Some testimony was taken before the hearing was continued for ten days to permit the submission of exhibits. The railroads contended that the voluntary cut to 30c. is a fair reduction. The company, on the other hand, insisted that the drop should be to 25c., asserting that rates have recently been reduced on Montana copper, that rates on African and Chilean copper are lower to New York than on Michigan copper and that the excessive and unfair rates in Michigan are ruinous to the Upper Peninsula industry and favorable to competitors. The company also asked that the railroads be required to rebate the difference between the proposed new reduced rates and the old rates on shipments of copper since the bill of complaint was filed.

Wellington Mines Co. Resumes Development at Breckenridge

The Wellington Mines Co., operating at Breckenridge, Colo., whose mine was closed down in June, will carry out a plan of development comprising the sinking of the shaft another hundred feet, the opening of a new level, and the development of oreshoots already opened on the levels above.

The mines are among the heaviest producers of zinc ore in the state, and were closed down on account of unsatisfactory markets and a burdensome increase in power rates, which went into effect earlier in the year. Operations at present will be confined to development work only, and the milling plants will not be started.

Central Eureka Strikes Oreshoot

The Central Eureka mine at Sutter Creek, Calif., has opened a new shoot of good ore on its 4,400 level in Central Eureka ground. The extent of the shoot will not be known until further development has taken place.

The level from the 4,400 station is opened by two crosscuts. From the south crosscut a drift is being driven north, and from the north crosscut north and south drifts are being extended. The new shoot came in on a fault in the north drift extending from the north crosscut.

Tintic Standard Interests Merge Group of Properties

North Beck, Warrior, and Sacramento Included—Development to Start at Once

Tintic Standard interests are involved in a new consolidation of mining properties at Eureka, Utah. The Warrior and Sacramento properties have been merged with the North Beck. The consolidation, comprising 500 acres of patented ground, will be known as the North Beck Mining Co. The ground lies northwest of the town of Eureka, and contains the dolomite beds which have been so productive in the Bullion Beck, Eureka Hill, and Centennial-Eureka. The company has also gained control of the Cable group.

Mine buildings are already being erected on the Sacramento group. An electric hoist and compressor will be installed. When the installation has been completed, the work of enlarging the shaft to three compartments will be undertaken and development work will be started on the 600 level. On the North Beck ground there is a 1,600-ft. shaft. Work will be started here as soon as water is available.

The North Beck Mining Co. is capitalized at 1,600,000 shares, instead of at 1,000,000 as formerly, the increase in capitalization having been made to obtain funds for the purchase of the new ground and for development. E. J. Raddatz is president and general manager of the company. G. H. Ryan will be in charge at the Sacramento, and A. Donelson at the North Beck.

Kellogg Celebrates Bunker Hill's Birthday

Mine Is Thirty-nine Years Old—Jacob Goetz, One of the Locators, Attends—An Ideal Mining Community in the Coeur d'Alene District of Idaho

By A. B. Parsons
Assistant Editor

THE PEOPLE of Kellogg, Idaho, had a birthday party on Sept. 26. The Bunker Hill & Sullivan mine was thirty-nine years old—older than most mines ever get to be. But that is only part of the story. In the last annual report for 1923, Stanly Easton, the Bunker Hill manager, said that the recent developments on the lowest level, 1,600 ft. below the Kellogg adit, gave "assurance of ore resources greater than at any period in the past history of the mine." Since the report was issued still more gratifying disclosures have been made. So it seems that this first formal celebration of the Kelloggians, most of whom are employees of the Bunker Hill company, ought to be followed by many more similar occasions as the years roll by.

The principal dignitaries, if they may be so called, at the birthday party, were Jacob Goetz, familiarly known as "Dutch Jake," and his partner of forty-two years' standing, Harry Baer. Jacob Goetz, trader, saloon keeper, and dealer in prospects, grubstaked Phil O'Rourke, who, with N. S. Kellogg and a white burro belonging to Messrs. Cooper and Peck, located the Bunker Hill claim on Sept. 10, 1885. The burro's part in the staking is specifically established by the legal decision of Judge Buck awarding an interest in the claim to the owners of the animal. Goetz himself was co-locator of the Sullivan claim that adjoined the Bunker Hill on the extension of the vein. He told his audience at the birthday banquet that the battle of Bunker Hill and the then champion heavyweight pugilist, John L., were honored in the selection of names for the claims. He related the early career of the property and told what had become of the other participants in the story. Most of them have passed over the Great Divide.

The property was sold to Simeon Reed, of Portland, Ore., in 1887, for $1,500,000. Later a company was formed and ownership was scattered. F. W. Bradley, of San Francisco, and his associates have long been in control.

With the exception of the year 1890, when no ore was mined, operating profit has ranged from $35,000 to $3,285,827 annually, the greatest profit being realized in 1917. Total earnings to Jan. 1, 1924, were $38,348,682 and dividends totaling $28,872,000 had been paid. Already this year $1,471,500 has been disbursed, bringing the total to $30 343,500.

The property is equipped with several concentrators and a modern lead smelter in which it makes refined lead and silver ready for the market. A leaching and electrolytic plant for the treatment of zinc-lead ores is to be built soon. The following figures show the results of operation in 1923:

Stanly Easton, manager of the Bunker Hill & Sullivan

Tons of ore mined	425,817
Mining cost, per ton	$3.23
Concentration cost, per ton	$0.791
Total Kellogg cost, per ton	$4.081
Tons of concentrate produced	72,585
Lead content, per cent	48.051
Silver content, oz.	16.22
Lead, price per lb., cents	7.249
Silver price per oz., cents	73.39
Gross value of ore	$5,968,275
Operating profit	$2,174,019

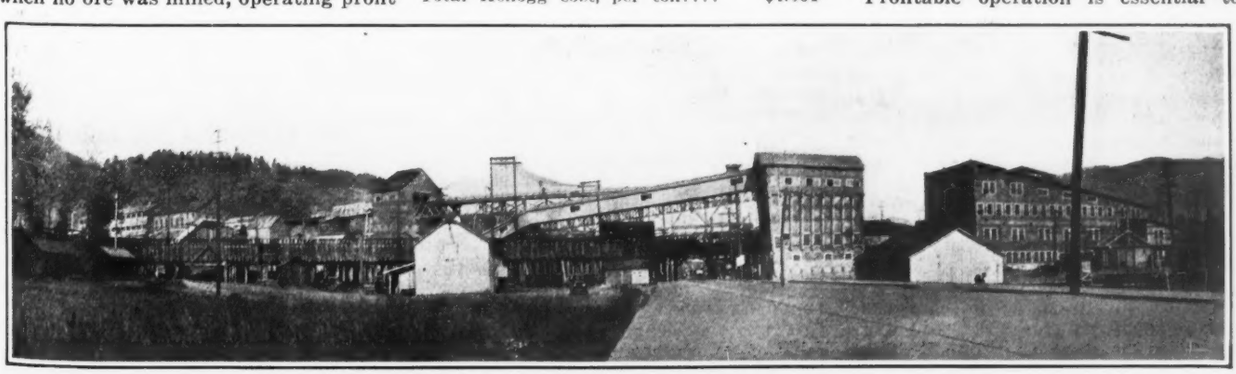
The seventy-five visitors from out of town were welcomed to the celebration by Mr. Easton, who was introduced by the chairman as "the biggest man in Kellogg—big in stature, but bigger in his attitude of helpfulness in all matters pertaining to the welfare of the community." In the accompanying snap-shot Mr. Easton (who will be surprised to see it) looks almost as tall as the house, but as a matter of fact he is only six feet five inches. As to the latter part of the statement, one needs only to visit Kellogg to confirm it. No more attractive town can be found, and although Mr. Easton does not have any official part in town government, his influences for good is easily detected. Decent, permanent homes and living quarters for everybody, including miners, are a feature of the community. It is a "company" town in the sense that all those who are not on the Bunker Hill payroll serve those who are. But it is free from the abuses so often found in the company town.

Mr. Easton went to work as a common miner at the Bunker Hill in 1896, and since 1902 he has been general manager. He still makes his home in a modest frame house next to the main office. In his remarks Mr. Easton recalled how in 1896, when lead was 2½c. a pound, things looked pretty bad, and few of the miners thought the "old girl" (meaning the mine) would live through the winter. Speaking to the guests he said:

"Unfortunately, most of those who made history in the early days of Wardner and Kellogg have passed on. But at least we have with us this evening two of those grand old pioneers, and we in this community extend to them the greeting that is their due. Upon their return among us they find this country as beautiful as ever, but with modernity and all the advantages such a change affords. Had they remained to absorb our smelter smoke and to take an occasional swig of our good old lead water they would be able to live forever. . . .

"The Bunker Hill hopes that the old-timers and the people of Kellogg approve of our accomplishment and what has been done in the direction of building up a happy and prosperous community here."

Profitable operation is essential to



Bunker Hill mills and concentrators at Kellogg, Idaho

At the Sacramento Meeting of the American

Among those in attendance were:
R. M. Catlin, Franklin, N. J.
A. B. Foote, Grass Valley, Calif.
F. W. Nobs, Grass Valley, Calif.
F. L. Sizer, San Francisco.
E. A. Hersam, Berkeley, Calif.
F. H. Probert, Berkeley, Calif.
W. S. Weeks, Berkeley, Calif.
L. C. Uren, Berkeley, Calif.
Robert Marsh, Ruth, Nev.
Albert Burch, San Francisco
W. W. Meni, San Francisco
F. W. Bradley, San Francisco
P. G. Beckett, Douglas, Ariz.
W. Val De Camp, Jerome, Ariz.
L. E. Reber, Jr., Jerome, Ariz.
W. P. Hammon, San Francisco
E. C. Hutchinson, San Francisco.
T. A. Rickard, San Francisco
Milnor Roberts, Seattle, Wash.
H. M. Payne, New York
H. C. Carlisle, San Francisco
H. T. Hamilton, San Francisco
O. McCraney, Shawmut, Calif.
A. S. Howe, Sutter Creek, Calif.
N. A. Dickerman, San Francisco
T. L. Oddie, Reno, Nev.
E. D. Boyle, Thompson, Nev.
G. D. Blood, Salt Lake City
H. C. Goodrich, Salt Lake City

the perpetuation of any large enterprise. There are many such; but a "happy and prosperous community" is something more rare. If Kellogg were not so happy, it probably would not have celebrated the Bunker Hill birthday as it did.

Smouldering Timbers Still Hinder C. & H. Operations

Shafts of the Hecla and South Hecla branches on Calumet & Hecla Consolidated in the Michigan copper district have again resumed operations, as gases from the fire in No. 4 shaft, Calumet branch, have subsided. The flames in No. 4 are confined to a small section of the shaft between the 52d and 63d levels. Operations cannot be resumed in the Calumet branch until the smouldering timbers buried under tons of rock cease to emit gas.

The situation is steadily improving. The damage is confined to burned timbers and caving of ground where the supports have given way. Once the shaft is clear of gas, the work of retimbering and clearing drifts will proceed promptly.

Prospect Nygren Placer Deposits on Idaho-Montana Line

The Nygren placer, on the state line between Idaho and Montana, near St. Regis, is being prospected by a crew of fifteen men with Keystone drills. The property consists of 250 acres of placer ground showing surface values of 15 to 30c. per yard, according to Mr. Nygren. A plan to share with the mine owners on a 50 per cent basis has been agreed to by a group of Tacoma business men. If the ground tests out, the Tacoma men will install a dredge to work the gravels. The work is in charge of Harry Townsend, formerly field engineer with the Anaconda Copper Mining Co.

Livermore Denies Shutdown of Smuggler-Union

Reserves Equal to Those of Year Ago —Profit on Current Operation —Active Development

Robert Livermore, president and general manager of the Smuggler-Union Mining Co., operating at Telluride, Colo., has issued the following statement concerning the company's affairs. He asks for the co-operation of the employees in making operations profitable. He says:

"As there have been rumors circulated that the mine will be shut down in the near future, which is naturally unsettling and disturbing to everyone connected with the company, the management wishes to let everyone know the facts as definitely as possible.

"There is no intention of shutting down the mine as long as there is ore in payable quantity and grade.

"The reserves positively in sight at the present time are about the same as they have been for the past year—namely two or three months run at the present rate of milling. Production beyond that must come from whatever new stoping ground is opened in the mean time.

"While no definite statement can be made, it is hoped and expected that, as in the past, development work will continue to keep at least this reserve ahead for some time to come.

"The management wishes to say that while a profit can be made from the ore at its present grade and tonnage, it is very small, and that very slight unfavorable factors may convert it to a loss, which cannot continue long without a stoppage of operations. Therefore, the co-operation of every employee is earnestly asked in the effort which is being made to keep the mine going successfully for the mutual benefit of all concerned."

Would Reorganize Idaho Gold and Ruby Co.

Two thousand stockholders of the Idaho Gold & Ruby Mining Co., which was recently thrown into the hands of a receiver with $2,000,000 in debts, have been asked to join a new Idaho Gold & Ruby Mining Co., which will have a capitalization of $1,000,000 in $1 shares, compared with the old capitalization of $6,000,000. The stockholders have been asked to trade in their old stock on a basis of 10 shares in the old company for 1 share in the new, accompanied by 2c. per share. Creditors holding interest-bearing certificates, first-mortgage contracts, and preferred stock will be allowed by the plan to obtain a share of stock for each $5 face value of their claims.

No Deterioration in Concrete Shafts at Michigan Mines

At the Seneca property, in the Michigan copper district, pumps continue in operation, and both the Seneca and Gratiot shafts are in good condition. Work at either of them could be resumed on short notice. There is no deterioration of the shafts because of their enforced idleness. Both the Seneca and Gratiot shafts are of reinforced concrete and there has been no caving. A few men are kept on the payroll to man the pumps.

Plan to Reopen Big Indian Copper Mine, in Utah

A report comes from Moab, Utah, that a number of Colorado mining men have been making an inspection of the Big Indian Copper mine, in San Juan County. It is said that a process for the treatment of the ore has been devised, which will make it possible to operate at a profit. A 300-ton leaching plant was built at the mine in 1917.

Mining Congress, Sept. 29 to Oct. 4

L. O. Howard, Pullman, Wash.
Thomas Harris, Marigold, Calif.
T. O. McGrath, Bisbee, Ariz.
C. B. Lakenan, McGill, Nev.
A. G. Langley, Victoria, B. C.
Charles A. Mitke, Bisbee, Ariz.
Frank Pagliuchi, San Francisco.
V. C. Alderson, Denver, Colo.
Andrew J. Stinson, Carson City, Nev.
L. A. Friedman, Lovelock, Nev.
W. B. Gester, San Francisco
N. H. Getchell, Battle Mountain, Nev.
S. P. Hutchinson, Philadelphia, Pa.
E. T. Lednum, of Denver, Colo.
H. Mortimer Lamb, Vancouver, B. C.
F. W. Maclennan, Miami, Ariz.
A. Cressy Morrison, New York
C. W. Merrill, San Francisco
A. G. Mackenzie, Salt Lake City
G. McM. Ross, Stockton, Calif.
G. B. Rosenblatt, San Francisco
V. S. Rood, Bingham Canyon, Utah
E. J. Shrader, Reno, Nev.
George Stahl, Denver, Colo.
E. J. Longyear, Minneapolis, Minn.
Bulkeley Wells, San Francisco
Stanley Arnot, Plymouth, Calif.
A. E. Ramstedt, Wallace, Idaho
Falcon Joslin, Seattle, Wash.
Jesse McDonald, Denver, Colo.
A. G. McLaughlin, Los Angeles
George Young, San Francisco
F. W. Monahan, Salt Lake City

See Possible Increase in Capacity of Sullivan Concentrator

The Consolidated Mining & Smelting Co. of Canada is seeking permission from the British Columbia Department of Water Powers to take 1,000 ft.-sec. of water from the Elk River for power purposes at its Sullivan mine. This would appear to be looking to the future, as the company has a ten-year contract with the East Kootenay Power Co. to supply power for mine and concentrator, of which about one year has elapsed.

It is possible, on the other hand, that the company has in view the increasing of the output of the Sullivan mine, which at present is restricted only by the capacity of the mill. The coarse crushing plant at the Sullivan mine has a capacity of 6,000 tons per day, and the mill was so constructed that at a relatively small expense its present capacity of 3,000 tons per day can be doubled.

Considering the existing condition of the lead and zinc market and the probable demand for zinc concentrate in Belgium after the Australian contracts lapse, in 1925, the increasing of the output of the Sullivan mine appears to be based on expectations that are not unreasonable.

Mazapil Copper Co. Opens New Group of Claims

The Mazapil Copper Co., operating in Coahuila, Mexico, has taken up about forty claims adjacent to the Norias de Bejan mines, which were recently acquired on lease and bond from Tobias Guzman. These properties are situated in the famous Sierra de Ramirez of the San Juan de Guadalupe district. As soon as machinery is installed heavy shipments of ore will be made to the company's lead smelter in Saltillo, according to present plans.

Tonopah Belmont Plans to Finance Jim Butler Development

Important Reorganization in Nevada Silver Camp—Large Block of Ground

For several months reports have been current that the Tonopah Belmont Development Co. would finance deep development work in the Jim Butler mining property at Tonopah, Nev., but no actual plans for raising the necessary money were known of until the recent letter to stockholders issued by Clyde A. Heller, president of the Jim Butler company.

The Jim Butler owns twenty-two claims, comprising 332 acres, most of which is undeveloped. The company has paid dividends amounting to $1,151,074, and at one time had a substantial sum in its treasury. Owing to unfortunate investments in outside properties, it was compelled to discontinue development work in its Tonopah property when developments in adjoining properties indicated ore possibilities which had not been tried.

The plan as outlined calls for reorganization as the Jim Butler Mining Co., capitalization to be increased from 2,000,000 to 2,500,000 shares. Present stockholders are to receive one share of new for four of old stock. The Tonopah Belmont company would receive 870,495 shares at the price of 15c. per share, this amount to cancel an existing obligation amounting to $130,506 due it from the Jim Butler company for moneys advanced for necessary current expenses and for joint financing on outside properties which did not prove to be profitable producers. A block of 700,000 shares is to be sold to the Tonopah Belmont at the rate of 15c. per share to provide working capital of $105,000, which is sufficient to complete development as outlined. This would leave 500,000 shares of stock in the treasury.

A stockholders' meeting, to consider the plan, has been called on Nov. 19 at the company's office in Philadelphia. There is reason to believe that the plan will be ratified by the stockholders, as it provides for necessary development work on a valuable property in a very productive district.

Red Bird, Lead-Silver Group, Will Be Developed

The Red Bird group, consisting of five claims located just over the international boundary line near Northport, Wash., has been taken over under lease and bond by Conrad Wolfle for a reported consideration of $50,000. The property is a discovery made this season by A. J. Campbell and G. E. Coulter.

The vein is wide, according to Mr. Wolfle, and has been opened by surface workings for 2,000 ft. Thirty samples taken by him indicate 10 to 30 per cent lead, 5 to 20 oz. silver and 5 to 15 per cent zinc. Two tunnels have been started 600 ft. apart following the ore along the footwall side. The Canadian government is building a wagon road to connect with the Metaline and British Columbia highway.

Nevada Rand Ships High Grade

The Western Ore Purchasing Co. recently paid $5,036.06 for a 30-ton lot of high-grade gold-silver ore from Nevada Rand Mine, in Mineral County, Nev. The ore ran 4.02 oz. gold and 189.50. oz. silver, or $213.52 per ton.

W. V. Rudderow, manager, says that an additional fifty-ton lot of ore will be shipped this month: and that another high grade lens had been encountered about 50 ft. east of the shoot producing this ore.

Work has been started on a crosscut at a depth of 350 ft. in the shaft in an effort to open the shoot 100 ft. below the 250 workings.

Washington News

By Paul Wooton
Special Correspondent

Aluminum Tariff and Monopoly Levy High Tax on Consumer

Federal Trade Commission Scores Aluminum Co. of America, Mellon "Interest"—Secondary Metal Factor

A political storm of some proportions is raging around the aluminum situation. The Democratic Presidential nominee has referred disparagingly to the "special privilege" granted the Aluminum Company of America in the present tariff law. This led the Secretary of the Treasury, referred to by the Democratic National Committee as the "spokesman for the Mellon family, which practically owns the Aluminum Company of America—the "aluminum trust"—recently to take issue with these charges, which brought a quick reply from the Democratic National Committee. When the controversy was at its height, the Federal Trade Commission issued a report which generally sustains the Democratic contention.

Secretary Mellon presents an analysis, accompanied by certain statistics, in which he says:

"It is clear that the tariff has had little effect on the price of aluminum. During the three years 1910 to 1912 the tariff was 7c. a pound, which is 2c. higher than it is today, and the average price of aluminum was 21c. During the period 1913 to 1921, when the tariff was 2c. a pound, the average price of aluminum was over 32c. During the last two years under the present tariff of 5c. a pound, the average price of aluminum has been 27c."

On the other hand the Democratic National Committee and John W. Davis, in a formal statement, have contended that "the existing rates are exorbitant and are unnecessarily high, adding many millions of dollars annually to the cost of aluminum products to American consumers."

The recent report of the Bureau of the Census is quoted to show that the value of aluminum products manufactured in 1923 has increased 133.4 per cent over that of 1921.

The Federal Trade Commission, in its formal report, finds that the Aluminum Company of America appears to have violated repeatedly the consent decree growing out of the suit against the company under the Sherman anti-trust act. The reports states, without qualification, that the Aluminum Company of America "practically has a complete monopoly of the production of aluminum in the United States and is the only domestic source of supply of metal for aluminum cooking utensil manufacturers."

The Trade Commission goes even further and says that the foregoing fact "combined with a high protective tariff enables the company to control the price of aluminum."

The reports reveal that the Aluminum Company of America dominates the Aluminum Goods Manufacturing Co., the largest producer of cooking utensils in the United States. The latter company is charged with questionable competitive tactics and with the maintenance of resale prices. Another manufacturer of cooking utensils is the United States Aluminum Co., a subsidiary of the Aluminum Company of America.

Secretary Mellon in his communication makes the point that secondary aluminum is produced in large quantities and is beyond the control of the manufacturer of ingots. In 1923 primary production was valued at $28,305,000, compared with $10,824,600 for secondary metal.

Phosphate Miners Appeal to Government on Franco-German Accord

See Export Business Ruined—Restoration of $3 Ocean Rate Asked —Moroccan Competition

In an effort to meet what it regards to be unfair competition, the Phosphate Export Association has appealed to the Federal Government, asking that its influence be used to prevent an agreement between France and Germany, under which the latter country would take all of its phosphate requirements from Morocco. An appeal also has been made to the Emergency Fleet Corporation asking that the $3 rate on phosphate be restored.

The Export Association has advices from Germany indicating that negotiations are pending which may result in the exclusion of American phosphate from the German market. Any such accord would be a severe blow to the American industry, which before the war was shipping annually nearly 1,500,000 tons of American phosphate to Europe. Though exports since the war have been somewhat less, the trade is still a large one. In 1923, exports of Florida pebble totaled 598,128 tons and those of hard rock phosphate aggregated 191,222 tons.

Last year the Export Association sent two engineers to Morocco to study the situation. They reported that American phosphate could compete successfully with the Moroccan product in Europe, with the possible exception of the countries bordering on the Mediterranean. That report, however, was based on the ocean freight rate existing at that time. Since then the rate has risen from $3 to $4.75. In addition to a certain amount of direct subsidy, it is understood that the French Government is omitting tax collections and subsidizing the industry in other indirect ways. As a result, the Moroccan output, which was 8,232 tons in 1921, will amount to 400,000 tons in 1924. The estimated output for 1925 is 550,000 tons. The 1926 production is expected to be 600,000 tons, which will be the full capacity of the works now completed and under construction.

The ocean freight rate situation is blamed by the Export Association for most of its trouble. When the $3 rate was in effect the Moroccan interests were disposed to enter into a price agreement or a fair division of territory in Europe. Plans were made for conferences in this country during the last summer. Before the time set for the conferences, however, ocean freight rates went up, and the Moroccan industry immediately lost interest. Thoroughgoing economies, however, have been effected by the American producers, and they now are absorbing the freight increase and are delivering their products abroad at the old price. This has had the effect of arousing the Moroccan interests to the point where they again wish to enter into a discussion of the matter of agreements.

The export association contends that it is in the interest of American industry to have the $3 rate restored. It is pointed out that the present demand for shipping will not continue after the grain movement, and that it would be only fair to protect the shippers of commodities whose forwardings are not seasonal. It also is insisted that failure at this critical time to secure lower ocean rates may allow American phosphate to be driven out of the European market—a position which if once lost might never again be regained.

Phelps Dodge Operates on 60 Per Cent Basis

THE Phelps Dodge copper production is being maintained on a basis of 60 per cent of capacity, and little change is expected. The Douglas smelter is turning out about 10,000,000 lb. a month, mainly from Copper Queen ores and from Copper Queen and Nacozari concentrates. Two reverberatories and two blast furnaces are being operated. No customs ores are being received.

The Bisbee concentrator is producing about 4,000 tons daily of low-grade ore from Sacramento Hill, and the mill at Nacozari about 2,000 tons a day. At Morenci, the remodeled No. 6 mill has capacity for 4,500 tons a day, but is not being operated at capacity. The Morenci branch smelter is turning out 3,000,000 lb. of copper a month.

The Burro Mountain properties of the company, at Tyrone, N. M., are still virtually idle.

War Minerals Awards

War mineral relief claims totaling $53,528 were recently awarded by the commission. The largest was to the Western Chemical Manufacturing Co., of Denver, Colo. It amounted to $23,740. The names of the claimants by states, with the amounts of the awards, follow:

Arizona	
Haigler and Sawyer, Phoenix	$3,488
California	
A. H. Jarman, San Jose	$10,526
Byrns Brothers, San Luis Obispo	2,830
Colorado	
Western Chemical Manufacturing Co.	$23,740
New York	
Suffern Company	$12,942

Barely Saves $400 Nugget from Oblivion

A GOLD NUGGET weighing 2 lb. and 9 dwt. created quite a sensation when exhibited in Wallace, Idaho, the other day. The nugget was 3½ in. long, 2 in. wide, and 1½ in. thick, and had considerable quartz attached to it. Its actual gold value was $400, to which should be added a substantial premium which would doubtless be paid by a collector of rare specimens.

The nugget was found by John Thiard, a veteran placer miner, on Trail Gulch, in the gold belt of the Coeur d'Alene district. It was taken from a drift on bedrock, along with a mass of boulders and gravel. Before sending it through the sluice boxes, according to custom in that class of mining, Mr. Thiard was removing the larger boulders with a five-pronged pitchfork. As he lifted the fork it held a rock almost black with iron stain and just a little too large to pass between the prongs. As he was about to heave it into the waste dump, it occurred to him that it was unusually heavy, so he examined it. Rubbing it against his overalls, the dull iron stain was replaced by bright yellow—the rock was a chunk of solid gold! It didn't go over the dump!

Aluminum Manufactures Increase

The extent of the growth of aluminum manufacture is revealed by the returns from the 1923 census of manufactures, which just have been made public. In 1923 this industry had an output valued at $106,930,367, which was an increase of 133.4 per cent over the 1921 output. Aluminum metal and other materials valued at $66,659,519 were used. The 1923 production came from 119 plants. In 1921 there were 87 plants.

Emergency Fleet Wants Oriental Shipments of Silver Bullion

The Emergency Fleet Corporation has shown the greatest interest in the matter of providing better facilities for the transport of silver bullion to the Far East. The matter was called to Admiral Palmer's attention recently by Senator Oddie. W. B. Keene, in charge of traffic for the Emergency Fleet Corporation, calls attention, however, to the fact that some of the government vessels already are equipped with strong rooms and have handled shipments of bullion. He makes it clear, however, that the Corporation recognizes that it is in the interest of United States trade, entirely apart from the revenue which accrues, to provide for the direct shipment of silver to India. Not only that, Mr. Keene has asked the co-operation of silver producers in securing as much as possible of this business for American flagships.

Ahmeek, One of C. & H.'s Best Bets, Makes New Record

Ahmeek, one of the richest units of Calumet & Hecla Consolidated, in the Michigan copper district, which has recently surpassed its best former record, is capable of a much greater output. September production was estimated at 2,300,000 lb. refined. The October output will be even larger.

Despite the fact Ahmeek is producing more than at any time in the history of the property, its present yield is only three-quarters of the possible peak. Ahmeek could easily extend itself to produce 3,000,000 lb. or more were it warranted by a better market price. Ahmeek is steadily increasing its already extensive reserves both in depth and lateral openings. Both Nos. 2 and 3-4 shafts reveal rock of average Ahmeek richness at depth. New drifts south from No. 2 into Allouez territory also will be productive of spendld stamp rock, and an extensive stoping area is available in the fissure vein of almost pure mass copper in No. 2.

Columbus Rexall Develops New Find of Silver Ore

Ore opened recently at the Columbus-Rexall mine at Alta, Utah, has attained a width of 20 ft. and thirty tons are being mined daily from development. The strike is a considerable distance from the old orebody; and it is thought that a new ore zone has been entered. The ore is carbonate, running high in silver, with some lead, and is a replacement of the limestone, associated with the intersection of a northeast-southwest fissure and a north-east fissure, and the Cardiff contact. Although the work at the discovery is about 150 ft. on an incline and 50 ft. vertically below the tunnel level, no water has been encountered.

Boston Montana Resumption Awaits Reorganization

According to W. R. Allen, president of the Boston Montana Corporation, operations at the company's mines at Elkhorn, Mont., will be resumed as soon as a reorganization has been effected. This, he says, will probably be within the next few weeks. L. S. Rodgers, of New York, who is in charge of the financial affairs of the company, has just returned from a trip to the mine, and expressed himself as pleased with the outlook at the property.

New Graphite Mine in Sonora

A new graphite property is being opened up by Francisco Lares and associates in the Guaymus district in Sonora, Mexico. Sonora is now producing more graphite than any other state in that country. The product is being exported principally to the United States and Canada, although some recent shipments have been made to Europe. This new mine is known as La Central and comprises eighteen contiguous claims. The graphite is of a superior grade and is found in large bodies.

London Letter

By W. A. Doman

Special Correspondent

W. R. Feldtman, M.I.M.M., Resigns and Public Wants Explanation

Initials Mean Much To Investors—Guarantee of Soundness, in Public Estimation

London, Sept. 30—The public on this side of the Atlantic places great faith in the integrity of engineers who are able to affix the initials M.I.M.M. to their names. This signifies that a man is a member of the Institution of Mining and Metallurgy. It is generally regarded as a guarantee of soundness, and these experts are able to influence capital in a way that is little short of remarkable. W. R. Feldtman, M.I.M.M, formerly consulting engineer to the Ashanti Goldfields, Ltd., was joint managing director of the West African Diamond Syndicate. He has now resigned that position and the shareholders are asking the reason. No official explanation has been given. There is no suggestion that the diamonds do not exist. On the other hand, it is reported that they are being sold, and are fetching good prices. A resignation of this character generally sets people thinking.

The Eileen Alannah squabble has taken another turn. To make certain of the prospects and to gain a proper conception of the position, W. Pellew-Harvey, who is a member of the Institution, has been engaged to proceed to Rhodesia toward the end of October to undertake an exhaustive examination of the property, and to report to the directors.

A certain amount of criticism has been aroused on the promotion of the Mondego Tin Dredging Syndicate (Portugal). Messrs Lake and Currie, the tin-mining experts, are the consulting engineers to the company, and have written a report upon it for inclusion in the prospectus. This apparently is not regarded as satisfactory by all concerned. Messrs. Lake and Curry express an opinion only upon the information supplied to them, which seems to indicate that they have not made an exhaustive independent examination. They consider the possibilities attractive. Comment has been made upon the fact that the estimate of profits in a preliminary statement does not agree with the estimate in the prospectus, which is the document upon which the public relies.

Although cable dispatches from South Africa regarding the proposed fixing of a higher ratio between white and black labor at the mines have suggested that official action will be taken in this direction, they have had little effect upon the share market. An invertebrate policy seems to obtain at Johannesburg. At one time it was regarded as necessary to get rid of a fair number of whites because the mines could not afford the expense of employing so large a proportion of white labor; now the companies themselves are enlarging their white staffs.

Johannesburg Letter

By John Watson
Special Correspondent

Mining Inspector Discusses Mine Supports and Tailing Dams

Safety May Be Assured With Less "Cribbing" — Depends on Conditions Underground

Johannesburg, Sept. 1.—In his presidential address to the Chemical, Metallurgical and Mining Society on Aug. 23, C. J. Gray, Mining Inspector, referred to the almost general practice of supporting the hanging wall in stopes by the systematic placing of stone packs, or "pigsties," filled with waste rock. This is done so thoroughly that the number of accidents from collapse of considerable areas of hanging wall is now small. Under the circumstances, he said, perhaps, one should not criticise; but we are all interested in the economical and profitable working of the mines. For example, where the hanging wall is strong, unbroken quartzite, ten feet thick, less support is needed than in the case of a broken hanging wall of only two feet thickness.

Another matter to which the president referred was the growing extent and unsightly appearance of the many slime dams on the Witwatersrand. On the central Rand, in particular, slime dams are rapidly filling the remaining open spaces of any size about the mines. As things are, it seems that the safe height, the proper batter for the walls, the rate at which the dam can be raised safely and other factors are decided by little better than guesswork. No one can give the factor of safety in a slime-dam wall. Possibly, he suggested, the time will come when such old dams will rival the hanging gardens of Babylon, and the view of the Crown mines, from the south, may be one of entrancing beauty.

A fresh discovery of alluvial platinum is reported on the farm Diamant, about 5 miles northwest of Naboonspruit railway station. This discovery has been made by Platinum Farms, Ltd., which is putting down a number of prospect holes to prove the property, over which the company has an option. High assays are reported to have been obtained.

In the week ended Aug. 23, the 5s. shares of Transvaal Platinum, Ltd., were dealt in, to a moderate extent, on the Johannesburg Stock Exchange and improved from 70 to 75s., with numerous transactions, mostly in odd lots. Rietfontein Platinum was dealt in between 9s. 3d. and 7s. in fair amounts. The shares of other platinum companies were inactive.

The general manager of the Messina Development Co., Ltd., reports a record month for July: 15,200 long tons of copper ore was hauled and 1,000 long tons of concentrate, (39 per cent copper), passed on to the smelters. The smelters also set up a new record with 515 tons of ingot copper, which amount is 60 per cent in excess of the designed capacity of the plant. Little development has been done either at Messina or Vogelenzang; but the exposures in the bottom level of the latter shaft show ore of better than medium grade.

According to A. L. Hall, the so-called South African jade is a heavy, hard, and compact rock composed almost wholly of grossularite (lime garnet). It possesses all the qualities of a semi-precious stone, and has been found well suited for the manufacture of articles of stone jewelry. The commonest color is green, not much different from that of the true jade.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Inside Manipulation Seen in Fluctuations of Dome Shares

Physical Condition of Mines Seems Good, Yet Stock Declines $1 Per Share—New Director

Toronto, Oct. 12—The recent gyrations in the stock of the Dome Mines are reported to be the results of insiders trying to discourage any further opposition against the directors, as was the case at the last annual meeting. It is unfortunate for the Dome and for the industry that this sort of thing happens, because it has a tendency to destroy confidence. There appears to be no physical reason at the mine for the stock suddenly dropping over a dollar a share, and so far as can be learned, everything is in good condition. Encouraging developments are reported on the tenth and twelfth levels, and on the twelfth level an ore-body has been opened for a length of 400 ft. with a maximum width of 110 ft. During September the mill treated 41,100 tons and recovered $360,968, or an average of $8.90, compared with $8.58 in August and $8.54 in July.

To satisfy the demands for another Canadian director, Wallace Nesbitt has been added to the board. Mr. Nesbitt was interested in the Dome in the early days of its history, but upon his elevation to the Supreme Court of Canada he had to give up all interests of this sort. He is well known in legal and financial circles, and his appointment will do much to settle the unrest in connection with this company.

The McIntyre mill, which was designed for a maximum capacity of 1,000 tons a day, is now exceeding this tonnage; it is treating between 1,100 and 1,200 tons a day and this can probably be raised to about 1,400 tons. This increase is being brought about without additions to plant or machinery and is due to slight mechanical changes. Credit for this is given to J. J. Denny, who recently assumed charge. The grade of ore treated is about $9, and on a basis of 1,400 tons a day the company should be able to earn at least 50 per cent net profits on the issued capital, against dividend requirements of 20 per cent.

A start has been made on the new 4.000 ft. shaft, but progress will be slow until after the first 100 ft. and until the shaft power is in place and heavier equipment has been installed.

It is understood that a settlement will soon be reached in the affairs of the Davidson company, of Porcupine, which will permit the company to rehabilitate itself. One of the chief points of dispute was the loan of £115,000 to the Porcupine-Davidson by the Davidson Consolidated; the former company refused to pay this loan, claiming that the property was sold by fraud and misrepresentation. The basis of settlement is that the Porcupine-Davidson will give three-year notes, without interest, for the face amount of the loan, but shall have the privilege within that time of turning the property back to the original owners and cancelling the notes. The Porcupine-Davidson has approximately $200,000 cash in the treasury, which is held up on account of the various actions which have been instituted in the courts, and if this settlement is effected this money will be free to provide funds to search for a new property.

Melbourne Letter

By Peter G. Tait
Special Correspondent

Revival of Gold Dredging in New Zealand Foreseen

Two Companies Formed to Operate on South Island—Rough Country Hampered Former Companies

Melbourne, Sept. 2—There appear to be good prospects of revival in dredging activity in the South Island of New Zealand. In the late 90's several plants were at work on the Kawarau River, which drains Lake Wakitapu, and on the Shotover River, which flows into the Kawarau. Lower down the Kawarau flows into the Clutha, or Molyneaux, River, which was the scene of active dredging operations.

The Kawarau and Shotover rivers are situated in rough mountainous country and carry large quantities of water. The banks in many places are precipitous. These facts hampered the early operators. It is said that very little gold was recovered from the beds of these rivers, although the beaches and terraces on the banks yielded large quantities.

The Kawarau Gold Mining Syndicate has been formed in Dunedin to install a dredging plant, and a Melbourne company, the Shotover Gold Dredging Co., has been organized to install a Thompson suction-cutter dredge on the Shotover River. If these companies meet with success there is little doubt that gold dredging in New Zealand will revive.

Antox, Ltd., is working the antimonial gold ores at Costerfield, near Heathcote, Victoria. Before the formation of this company the concentrates were shipped to England, but smelters have now been erected. Up to the present the financial result has not been satisfactory, but it is estimated that by maintaining the output at the present figure of 100 tons of concentrates per month, the result will be more satisfactory.

Men You Should Know About

W. C. Alden has completed his summer's geological work in Wyoming.

Gerard W. Williams has left London for the Tanganyika territory, in Africa.

J. L. McLaughlin, of San Francisco, has examined the Emerald mine, at Salmo, West Kootenay.

S. F. Shaw has returned to San Antonio from a professional visit to the Corsicana oil field, in Texas.

Dyke V. Keedy, consulting and metallurgical engineer, is engaged in exploration work in the Guianas.

W. Peterson, State Geologist for Utah, has examined properties in the Revelstoke district of British Columbia.

Henry J. Gifford has returned to England from Australia, where he has been inspecting properties for some months.

Wilbur E. Saunders, formerly of Butte, Mont., is now associated with the California Mac-Van Co., of Sacramento, Calif.

R. M. Wilson has finished his geological assignment in the Hyder district of Alaska and is en route to Washington, D. C.

J. T. Pardee has completed his phosphate examinations at Ogden, Utah, and now is engaged in similar work at Victor, Idaho.

Allen A. Davidson, consulting engineer to the Keffi Consolidated Tin Co., will soon visit that company's properties in Nigeria.

J. S. Bache, of New York, president of the Dome Mines, recently visited the company's property in South Porcupine, Ontario, Canada.

Fred L. Cole, of New York, has arrived in Tonopah, Nev., to take charge of the Montana Tonopah company's operations.

Claude Maitland is now in the Gold Coast Colony, in Africa, on professional business. He is expected to return some time this year.

W. C. Mendenhall, of the U. S. Geological Survey, is making a field trip in Michigan, the Black Hills, Colorado, Oklahoma, and Texas.

Dean E. Winchester, consulting geologist, has changed his address from 607 E. & Co. Building, Denver, Colo., to 440 Steel Building, that city.

A. N. McDonald and **Pat McBride** are opening up the Sunrise group, near the head of Salmon Glacier, in the Portland Canal district of British Columbia.

L. W. Stephenson is in Texas, where for several months he will be engaged in field studies of the Upper Cretaceous and in work on the new state map.

H. G. L. Kenrick has left London for Kenya Colony, in British East Africa. No announcement has been made as to the nature of his mission.

M. E. Fisher, of Wallace, Idaho, resident ore buyer for the American Smelting & Refining Co., in the Coeur d'Alene district, is visiting in Pueblo, Colo., his former home.

J. R. Brown, builder of several prominent mills in Mexico, has been appointed construction superintendent of the Pittsburgh Vetagrande Mining Co.'s properties at Zacatecas, Mexico.

Gelasio Caetani, Italian Ambassador to the United States, sailed from Naples on Oct. 11 to return to his post in Washington, where he will remain until his retirement on Jan. 1, 1925.

H. G. Palsgrove has resigned as superintendent for the Smuggler-Union Mining Co., at Telluride, Colo., and has gone to Denver, his present address being 4147 Stuart St., in that city.

John A. Reid

John A. Reid, formerly engineer for the O'Brien interests in northern Ontario, has been appointed engineer for the Bingo Gold Mines, in The Pas district of Manitoba.

Captain A. M. Yonge, mining engineer, is in Cuba acting as general consulting engineer for the General Sugar Co., of Havana, supervising the scientific purchasing of supplies and machinery for twelve large sugar producing estates.

M. J. Kirwan is at Bartlesville, Okla., acting as superintendent of the petroleum experiment station of the U. S. Bureau of Mines. The former superintendent, **T. E. Swingart,** has resigned. Mr. Kirwan is assisted by **R. A. Cattell.**

A. L. Burns has been made general manager of the Gulf Publishing Co., of Houston, Tex. This company publishes *The Oil Weekly, The Refiner and Natural Gasoline Manufacturer,* and *The Filling Station.* Mr. Burns has been employed by the Gulf Publishing for a number of years.

John Gross, a metallurgist on the staff of the U. S. Bureau of Mines, who has been working on an investigation of milling practices at the Massachusetts Institute of Technology, has been transferred to the Salt Lake City station of the Bureau, where he will work on ore-dressing problems.

V. C. Heikes, statistician for the U. S. Geological Survey, and **Dr. L. F. McLoughlin,** geologist, are making a survey of the recently opened ore deposits of Utah. Among other investigations, the scorodite deposits of the Western Utah Copper at Gold Hill, in Toole County, are being examined.

Frederick Burbidge, of Wallace, Idaho, general manager of the Federal Mining & Smelting Co., left on Oct. 4 for the Oklahoma zinc fields, where his company is extensively engaged in zinc production. Mr. Burbidge will visit the New York headquarters of the company before his return to Wallace the latter part of October.

W. Taylor Thom, Jr., has been placed in charge of the section on geology of fuels of the U. S. Geological Survey, with the title of geologist in charge. His appointment has for its object the bringing together into one administrative unit the related work of the sections of coal and of oil and gas in the division of geology, the old fuel section of the Survey, by combining the separated sections.

H. DeWitt Smith's resignation as general superintendent of the United Verde Copper Co. has been followed by the appointment of **W. Val De Camp** to that position and several other appointments and promotions have been made in the company's organization. **C. E. Mills** has been made chief engineer, **W. W. Lynch** assistant mine superintendt, **H. A. Wright** general mine foreman, **T. W. Quayle** chief bonus engineer, and **W. P. Goss** chief efficiency engineer.

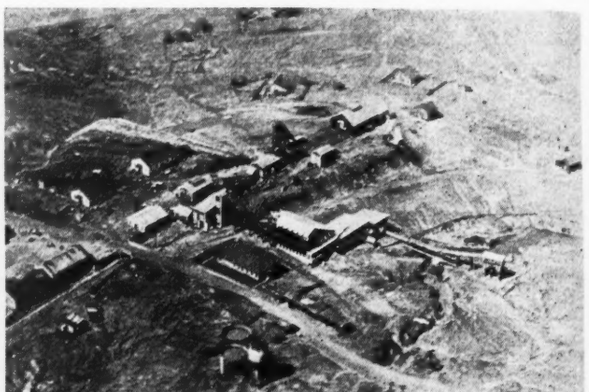
Dr. A. Wade, an American oil expert engaged by the Australian Federal Government to investigate oil prospects in the Northern Territory of that continent, reached Brisbane, Queensland, after making his examination of that region, in the middle of August. He brought a sensational story of the murder by the natives of the captain, officers, and crew of a steamer named the "Douglas Mawson," which was lost in the Gulf of Carpentaria waters several months ago, and of the wife and fourteen-year old daughter of the captain being held in captivity by the savages. Dr. Wade expected to prepare his geological report for the government on arrival in Melbourne.

Obituary

Hugh McCaffrey, a pioneer prospector of British Columbia and the Yukon, died in Toronto on Oct. 5 following an operation, at the age of seventy years. He was one of the first men to pass over the Cariboo trail to British Columbia, and also went over the Klondike trail in the gold rush.

Major John Ley Retallack, a pioneer in the Kootenays, died on the trail in northern Alberta, on Oct. 4. Major Retallack was born in Quebec in 1863 and was educated in England. He returned to Canada in 1883, and served with the Northwest Mounted Police for five years, when he received his discharge, with the rank of sergeant. He settled in the Kootenay in 1890, where he engaged in mining, railway construction, and ran a private bank. For a time he owned and operated the Whitewater mine and Whitewater Deeps, which a few years ago was taken over by a company, of which he was the principal shareholder. He served through the war, was at Ypres and the Somme, and afterward acted as D. A , Q. M. C., Canadian Railway troops.

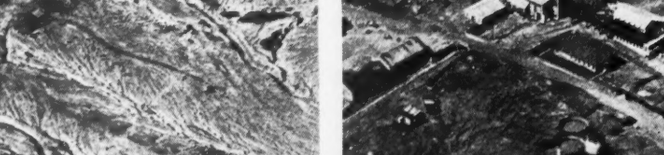
An airplane view of the plant of the Ocoee Copper Co.
A landscape typical of the district



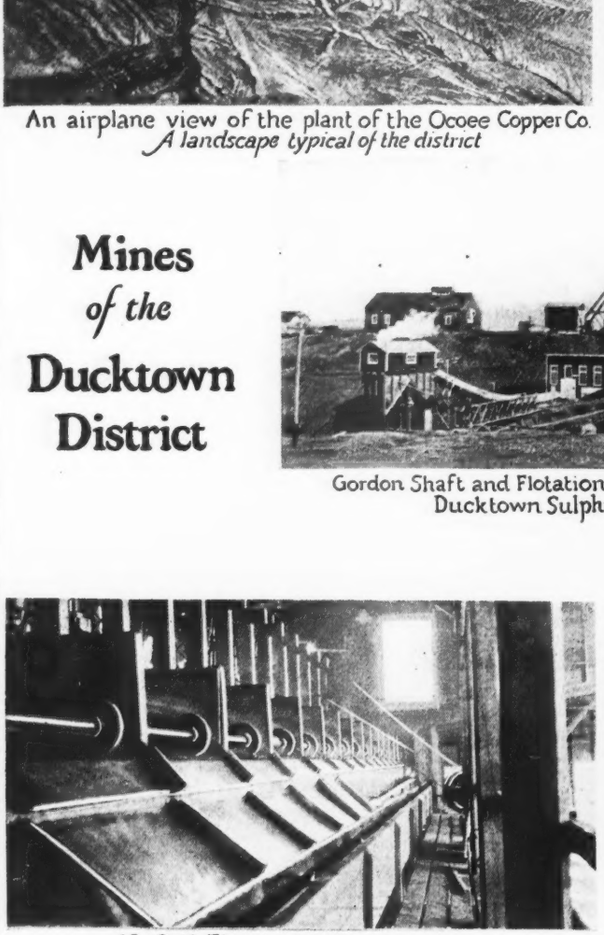
D.S.C.&I.Co. Maryland Mine
from the air

Mines *of the* Ducktown District

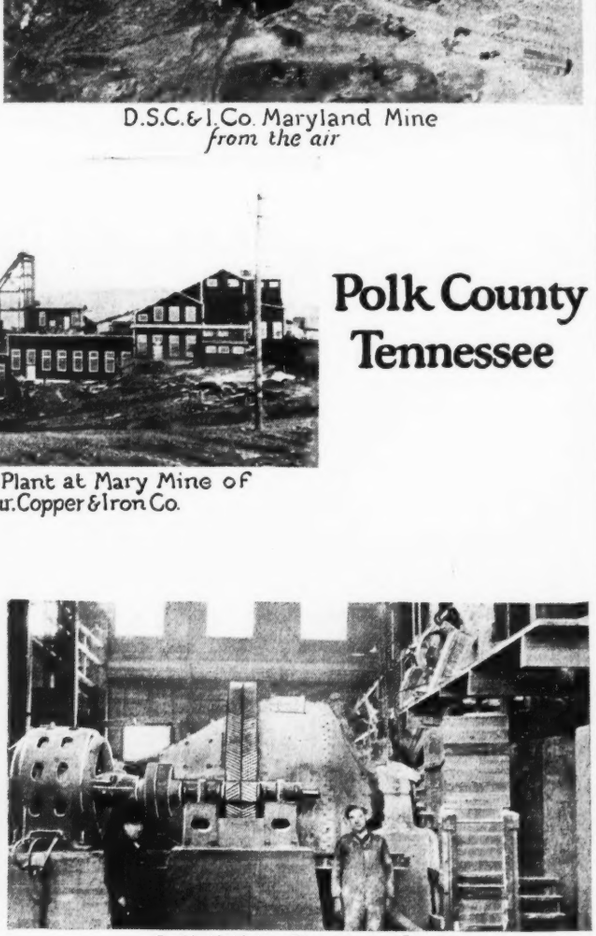
Polk County Tennessee



Gordon Shaft and Flotation Plant at Mary Mine of
Ducktown Sulphur, Copper & Iron Co.

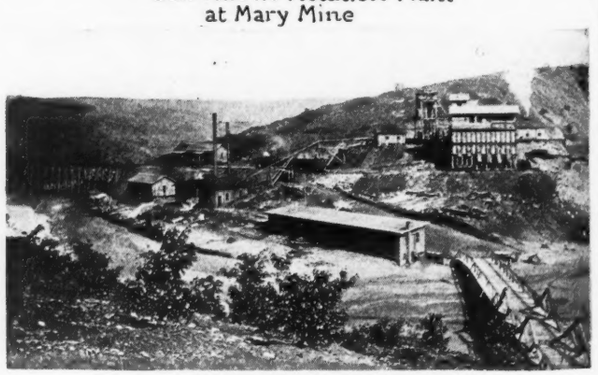


16-Cell Flotation Machine at
Mary Mine D.S.C.&I.Co.



Ball Mill in Flotation Plant
at Mary Mine

East Tennessee Mine, D.S.C.& I. Co.



Copper Pyrites Corporation

A.I.M.E. Visits Mascot and Ducktown

Engineers and Guests, Starting from Washington, Take In Many Points of Interest in First Week of Annual Field Meeting

Staff Report

ENGINEERS who have the leisure and can afford it constitute the larger part of those who take in the field meetings of the American Institute of Mining and Metallurgical Engineers that are held annually in the fall, as the president of the Institute, William Kelly, remarked recently in a speech at Knoxville. Business of various sorts draws others, and added to them all is a sprinkling of ladies that lends color and a touch of distinction to the party. These field meetings are in a class by themselves. Few conventions offer such a combination of opportunities for sociability and fraternization, for visiting places of technical interest and for technical discussion, as do these. Traveling and living in a special train of its own, the party proceeds from point to point along the scheduled route, with dinners, lunches, and even dances, to say nothing of a technical session or two, marking the intervals on the program.

The route this year was laid through the South from Washington to Birmingham and return. Among the places to be visited were the caverns of Luray and those of the Shenandoah, in Virginia; the busy Pocahontas coal field, in West Virginia; the zinc camp of Mascot, in Tennessee; and the copper mines, mills, smelters and acid plants of the Ducktown basin, just north of the Georgia state line and west of the North Carolina boundary. Thence to Birmingham, with its iron and coal mines, its ovens, furnaces and steel manufacturing plants, the route as planned then passing by the famous Muscle Shoals and the Wilson Dam. Following this route last week, members who started out from Washington on the evening of Oct. 7 got as far as Chattanooga by Sunday, Oct. 12, and were due to arrive in Birmingham the following day for a three-day visit in that remarkable area.

Sartorial Complexities

The meeting opened with a banquet at the New Willard Hotel, in Washington. One of the features of these field meetings is the extent of wardrobe and variety of costume displayed. Throughout the trip the question of what will be worn is almost as intriguing as the matter of what is to be seen en route. The problem of stuffing digging clothes and evening clothes with raiment of intermediate kinds all into one suitcase is generally solved by multiplying the number of bags and grips, and those who have wished to travel simply with, say, a toothbrush and a cigar box, in Mark Twain fashion, are either embarrassed or disappointed, according as they do or don't. The atmosphere that results is a hybrid one of formality and informality, as an observer might have noted at the dinner at the Willard.

Secretary Hoover served as toastmaster or chairman of the occasion. Brief remarks were made by William Kelly, president of the Institute, and Colonel Arthur S. Dwight, who was president two years ago. Mr. Hoover himself delivered the principal address. He chose for his theme the large sums spent by the government on research, $65,000,000 annually, though only 2½ per cent of the total expenditure at that. Few engineers would object to this, he said, for it was the only part of the government expenditure that yielded a profit and of which the net result was to reduce taxation instead of increasing it. The amount so spent could well be doubled, he said. Invention came no longer from the garret but from the research laboratory. Scientists thus engaged should be cared for better by the government. He cited a case where four researchers were killed by a laboratory explosion. The amount that could be paid to the twenty-two dependents of these four totaled just $930, and the government was forced to seek relief for them from private industry with which it had been co-operating in the research work done. Mr. Hoover also urged a greater interest in public affairs on the part of the engineers. The engineer was the servant of the truth and was swayed only by facts and not by the emotions, he said.

Luray Caves Visited

The following morning found the engineers' train at Luray, Va., where the forenoon was spent in visiting the well-known caves, which are reached by a short bus ride from the railroad station. To those who had not seen these grottoes, with their beautifully colored stalactites and stalagmites and grotesquely decorated walls, the visit was well worth making, though caves and grottoes are no rarities to the average mining engineer, perhaps. In the afternoon, the grottoes of the Shenandoah, further along the route and rivaling the caverns of Luray, were visited. The train proceeded then to Roanoke, where local members of the Institute entertained the party during the evening with informal hospitality.

An 86-mile trip by auto through the Pocahontas coal field was made Thursday, a day long to be remembered. Starting from Bluefield, W. Va., motor cars provided by the Pocahontas Operators' Association took the members rapidly through the district. Fourteen miles from Bluefield a stop was made at the tipple and sizing plant of the Booth Brown Coal & Coke Co. to permit the members of the party to see the preparation of coal. A few miles further on, at the Delta mine of the Pocahontas Fuel Co., a Coloder underground loading machine was seen at work. This machine—the invention of James Elwood Jones, of the Pocahontas Fuel Co.—is of large capacity and readily handles good-sized lumps. It is electrically operated. At Gary, almost 50 miles from the starting point, where the general offices of the United States Coal & Coke Co. are situated, luncheon was served at the company club house. Afterward, an opportunity was given to see the O'Toole mining and loading machine at work in the No. 6 works at Ream. This remarkable machine, invented by Col. Edward O'Toole, the general manager, was engaged, when seen, in robbing a pillar on the retreat. The space available does not permit a description here. Suffice it to say that a slice 43½ ft. deep was being taken out from the side of the room for the full length of the room, the coal being undercut across this 43½ ft. face by a cutter bar that was continually being forced forward into the coal by feed screws working against heavy jacks set in a row about 5 ft. back of the face. These jacks are advanced one at a time, the shale roof caving behind them as they are moved forward. The coal, thus undercut, is picked down, falling onto a pan conveyor running along the face, just back of and above the cutter bar. The coal is loaded into cars. There seems little opportunity for this machine except in coal mining, but it is a development that is at least of general interest.

Leaving Gary, the engineers' party returned to Bluefield by a different route, passing various mines and points of miscellaneous interest in the Pocahontas field. Some of the members visited the dry-cleaning plant (coal) at McComas during the day.

Increasing Zinc Demand Certain

Rather late the following morning, Friday, the party arrived at Mascot. Too little time was allowed on the program for seeing this interesting camp of the American Zinc Co. of Tennessee. After a visit underground or around the surface and through the mills and limestone plant, the party was entertained at luncheon in the Community Hall at Mascot. Arthur Thacher, in the course of a short talk on this occasion, said that within ten years the United States would call for twice the zinc it is using today and that the American engineer could solve the technical and cost problems involved.

Marble Quarries Visited

Considerable marble is quarried near Knoxville, and two of the quarries and a finishing plant were visited in the afternoon. The quarries were those of the Appalachian Marble Co. and the Grey Knox Marble Co. The marble is quarried by the latter company by machine drills, channeling machines, and wedges, in blocks as large as 8,000 cu.ft., which are then cut into smaller blocks ranging from 150 to 400 cu.ft. in size. The maximum size of block that is lifted from the pit depends on

Panoramic View of the Mining Settlement

the capacity of the derricks, which can handle pieces up to 45 tons in weight. The marble runs about 180 lb. per cubic foot. The marble being produced today is pink or gray, the demand calling for this. A chocolate-colored variety is also to be had, and formerly was in much demand.

In the evening a dinner and dance were given at the Whittle Springs Hotel, a resort on the outskirts of Knoxville. Colonel William S. Shields, president of the City National Bank, was toastmaster. Frank Bane, director of the Department of Public Welfare of Knoxville, welcomed the guests to the city. The other speakers were Mr. Kelly, president of the Institute; Dr. Harcourt A. Morgan, president of the University of Tennessee; Wilbur Nelson, state geologist; and Philip N. Moore, past president of the A.I.M.E. Mr. Moore laughingly said, with reference to the mineral resources of eastern Tennessee, that on thirty or forty of these field trips the A.I.M.E. had discovered the center of mineral wealth of the United States. Becoming serious, he said that he had been one of a group that during the last five or six years had been trying to integrate the profession and to get engineers to take an interest in public affairs and do something besides their engineering work. He then turned his attention to Muscle Shoals, which had been referred to earlier by Dr. Morgan. Mr. Moore, citing figures of the Army engineers themselves, pointed out greatly exaggerated claims were being made as to the power possibilities of the Wilson Dam and of the other dams projected or the construction of which was being urged in connection with it.

Leaving Knoxville early the next morning the party proceeded 112 miles south to Copperhill and Ducktown, in the southeastern corner of Tennessee. Lunch was served on arrival at the Cowanee Club of the Tennessee Copper company, at Copperhill. A speech of welcome was made by J. N. Houser, general manager of the Tennessee company which was answered by Mr.

Reduction Works of the Tennes

in the Ducktown District, in Tennessee

Kelly. E. F. Eurich, who was traveling with the party, then was called upon. Mr. Eurich had done work in the district in 1866 and '67, just after the Civil War, and told many interesting facts of those early days in the Ducktown basin. The party was then taken over the company's railroad to the flotation plant at the London mine, where the copper in the ore is being floated and the iron dropped. The total output of the London mine is being treated here, together with the minus ¾-in. product from Burra Burra. Of the total tonnage hoisted at the two mines, approximately 1,600 tons at present, about 500 tons is being treated by flotation. Those interested were taken underground in the Burra Burra mine, entering by the McPherson shaft and passing through the 12th level to the Burra Burra shaft and thence to the surface. The method of stoping now being used was explained, as well as the interesting so-called Victory chute, which has been developed by the company. The one other important operation in the district, that of the Ducktown Sulphur, Copper & Iron Co., was not inspected, owing to the limited time available. The officials of that company, however, were among those who welcomed the members to the district. A trip through the huge acid plant of the Tennessee company completed the journey of inspection, and at 5 o'clock the special train was once more on its way—this time for Chattanooga.

Lookout Mountain Again Conquered

Sunday was spent at Chattanooga. After breakfast the party left in automobiles for Lookout Mountain. Dinner was served at Signal Mountain Inn, after which the members again proceeded by their special train, now headed for Birmingham, where the technical sessions were to be held. The account of the proceedings and the description of the visit to the mines and plants of this great coal, iron and steel district will appear in the next issue of *Mining Journal-Press*.

Copper Co., at Copperhill, Tenn.

Societies, Addresses, and Reports

National Safety Congress Meets at Louisville

Membership Shows Healthy Gain—Attendance Satisfactory and Sections Well Representative

The convention of the National Safety Congress, held at Louisville, Ky., which ended early this month, exceeded in attendance any other meeting of the congress, the mining section being especially representative. The first day of the meeting was given over to the annual gathering of members in the morning and a general session in the afternoon. Among the speakers at these two meetings were James J. Davis, Secretary of Labor; Richard F. Grant, president, Chamber of Commerce of the United States; C. F. Kettering, vice-president and chief engineer, General Motors Research Corporation, and Dr. Arnold L. Jacoby, director, Psychopathic Clinic, Detroit.

At succeeding sessions papers were read by E. E. Jones and C. L. Colburn, and at the session held on Oct. 1, Francis Veehan, Mine Safety Commissioner of U. S. Bureau of Mines, addressed the mining section on "Organizing the Mining Industry for Safety." Theodore Marvin read N. S. Greensfelder's paper on "Safety in the Use of Explosives."

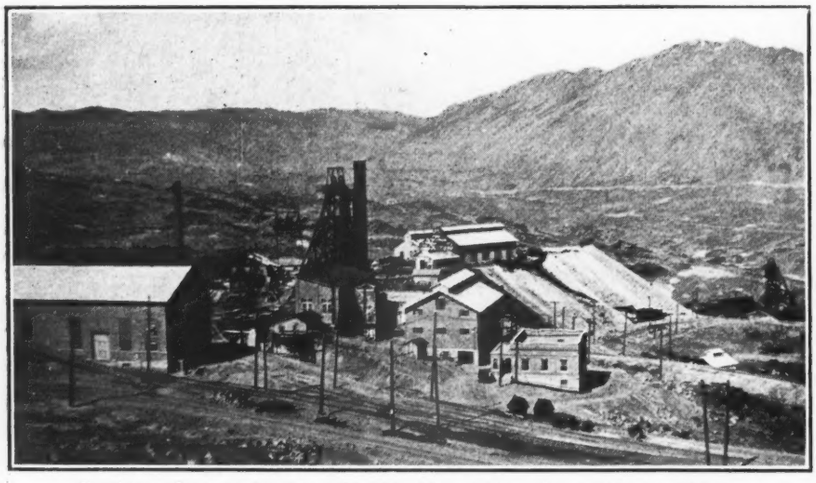
At the annual banquet Colonel A. B. Barber, of the National Safety Conference, made an address in behalf of Herbert Hoover, Secretary of Commerce.

Announcements were made of the following new officers: President, C. B. Auel, safety engineer, Westinghouse Electric & Manufacturing Co.; vice-president in charge of public relations, L. R. Palmer, Equitable Life Assurance Society, New York City; vice-president in charge of general activities, L. A. DuBlois, safety engineer, E. I. Dupont de Nemours & Co.; vice-president in charge of public safety, David Van Schaack, Aetna Life Insurance Co., Hartford, Conn.; vice-president of local safety councils, George T. Fonda, Fonda-Tolsted, Inc., New York City; vice-president in charge of industrial safety, Henry A. Reninger, Lehigh-Portland Cement Co., Allentown, Pa.; vice-president and treasurer, C. B. Scott, Bureau of Safety, Chicago, Ill.; secretary and managing director, William H. Cameron, Chicago, Ill.

The nominating committee recommended the following members of the mining section for election: R. Dawson Hall, engineering editor, *Coal Age*, New York City, for chairman; J. L. Boardman, safety engineer, Anaconda Copper Mining Co., Butte, Mont.; J. W. Reed, safety engineer, Consolidation Coal Co., Fairmont, W. Va.; R. B. Ageton, Tristate Zinc & Lead Ore Producers' Association, and A. A. Bowden, safety engineer, Pickands. Mather Co., Ironwood, Mich., as vice-presidents; T. T. Reed, director of Safety Service of the U. S. Bureau of Mines, was nominated secretary. The men whose names were presented were duly elected.

Editor of "Power" Is Honored

Fred Low, editor of *Power*, was awarded the degree of Doctor of Engineering by the Rensselaer Polytechnic Institute on Oct. 4, the occasion being the celebration of the hundredth anniversary of the founding of that institution. Dr. Low has been editor of *Power* since 1888, at which time he was twenty-eight years old. He is the current president of the American Society of Mechanical Engineers and has held many other honorary offices. His feature editorials on the first page of *Power* are known far and wide among the engineering fraternity for their combination of sound common sense and idealism.



Surface plant of Senator Clark's Elm Orlu mine at Butte, Mont.

German Metal Imports in 1924 Less Than Last Year

Despite Dislocation Incident to Ruhr Invasion in 1923—U. S. Suffers Most From Drop in Copper

Imports of non-ferrous metals by Germany in the first six months of 1924 showed a decline in comparison with the corresponding period of 1923, despite economic dislocation in that year incident to the Ruhr invasion, Trade Commissioner William T. Daugherty, Berlin, reports to the U. S. Department of Commerce. Smaller imports this year confirm the otherwise critical situation in German industry, marked by capital stringency, credit shortage, and accompanying high production costs and low activity of the existing productive plants and available equipment.

Imports in the first six months of 1924 are considerably below the level of the first half year of 1922, when industrial operations were more nearly normal than at present.

Exports of non-ferrous metals increased slightly over the corresponding 1923 level, except those of copper and zinc, which are, however, the leading bulk commodities among the non-ferrous metals.

Germany's copper imports in the first six months of 1924 averaged 7,338 tons monthly, against 8,432 tons monthly in the corresponding period of 1923. This reduction of imports affects sales from the United States particularly, as Germany is America's best customer for this metal and this country furnished 84 per cent of the copper brought into Germany during the first half of 1924. The reduced market this year can be traced to the financial stringency prevalent there.

The following table shows the quantitative comparison of imports in the first six months of this year, compared with 1923:

METAL IMPORTS INTO GERMANY, IN METRIC TONS

	First Half 1924	First Half 1923
Copper	44,031	50,595
Zinc	16,903	19,817
Lead	15,340	17,206
Tin	3,973	3,327
Aluminum..	2,579	2,334
Nickel	756	859
Antimony .	663	795

Power Conference Will Stimulate Hydro-electric Development

Hydro-electric development throughout the world is certain to be stimulated by the World Power Conference, in the opinion of O. C. Merrill, executive secretary of the Federal Power Commission and general chairman of the American Committee of the World Power Conference. "Delegates from forty nations attended the conference who will return to their countries," said Mr. Merrill, "with a new realization of the potentialities of their water-power resources. They now have precise information as to what other countries are doing and have a more accurate idea as to the feasibility of developments in view of what they have learned as to the experience in other countries."

Recent Technical Publications

Reviews, Abstracts, and References

A Better Business Letters Course

Principles of Business Writing. By T. H. Bailey Whipple. Published by the Westinghouse Technical Night School Press, East Pittsburgh, Pa. Price $2.

Industry of every kind, especially since the creation of our great corporations, has long been burdened with tremendous waste—waste of labor, energy, time, paper, printing, and postage—by the untrained, incompetent, and slovenly correspondent. We have observed no more striking and significant proof of the realization of this fact than Mr. Whipple's "Principles of Business Writing." The great Westinghouse company of Pittsburgh conducts a night school and runs in connection therewith a printshop—the Night School Press—which publishes technical books, reference works, and textbooks; and the company also employs a *literary critic*, Mr. Whipple. Westinghouse sells merchandise—and service. Those directing its policy and destinies have recognized the wasteful conditions known to most executives and managers, and have adopted the at first expensive but ultimately profitable expedient of education and training in correspondence as a distinct and important branch of company activity.

A score or so of books on how to write have appeared within the last year. For the business man and woman, for the executive and the engineer, Mr. Whipple's volume is perhaps the best, as a business tool. His list of "dont's" is excellent, and fairly complete. In ensuing printings he may well add "fabricator" (used for maker or manufacturer); "lineal" (used for linear — and persistently — by engineers); "end" (the "financial end," not intended to imply bankruptcy); "commission" (all manner of objects are "commissioned" by many writers); "some," for about; and the trite "in order," which nine times out of ten is out of order. With Mr. Whipple, we often have occasion earnestly to desire that, in making reports, engineers and other writers would consult the most handy dictionary and learn just what "proposition" means. With many who ought to know better it covers practically all nouns.

Persistent and obdurate offenders, barnacled to obsolete, threadbare, and wearying forms of expression, will hurl the classics at Mr. Whipple and at all others engaged in like endeavors — oblivious of the fact that to prove a thing clothes it with no competent authority and gives it no sanction of present good usage.

"Principles of Business Writing" is well titled. In appendices are presented examples of how to handle difficult problems in correspondence, suggestions to authors (these are by George McLane Wood), and test questions and answers—all practical and useful. A list of books recommended is helpful to the student of the subject discussed, and might well be extended to include at least three works not noted — T. A. Rickard's "Technical Writing" (John Wiley & Sons), "English for Engineers," by S. A. Harbarger (McGraw-Hill Book Co.), and "Words and Their Ways in English Speech," by Greenough & Kittridge (Macmillan).

T. H. Bailey Whipple

The good example of which Mr. Whipple's work is eloquent evidence may with advantage be followed by nearly all large business organizations. The effective and efficient business correspondent must impart to his letters something of culture, refinement, and courtesy, as well as technical and commercial knowledge. Until this matter is given the attention which its importance warrants, a great mass of mail will continue to find burial in the wastebasket, where, it must be admitted, much of it truly belongs.

W. N. P. Reed.

Patents

Roasting Furnaces — No. 1,506,266. Aug. 26, 1924. Georg Stohn, Stolberg, Germany. Design of a removable rabble to be attached to the rabble arms of mechanical roasting furnaces.

No. 1,506,942. Sept. 2, 1924. R. D. Pike, San Francisco. Design of a multiple-hearth mechanical roasting furnace, with air-cooled arms.

Miner's Cap—No. 1,506,608. Aug. 26, 1924. Frank Bayer, Majestic, Ky. An attachment on the front band of a miner's cap for holding a lamp.

Zinc Smelting—No. 1,506,609. Aug. 26, 1924. E. S. Berglund, Djursholm, Sweden. A method of converting zinc powder into fluid zinc. The powder, as it comes from the condenser, is stirred and subjected to centrifugal force, whereby conversion to the fluid state and cohesion of the fluid particles is effected, as well as separation of the oxide from the fluid metal formed.

Oxidized Ores—No. 1,505,663. Aug. 26, 1924. W. G. Perkins, London, England, assignor to Metals Production Co. of North America, Inc., New York. Oxidized ore is heated in the presence of sulphur compounds and a magnetizable metal in an atmosphere which will not react vigorously with the materials to remove sulphur rapidly. The purpose is to impart magnetic properties to the oxidized ore.

Waste-heat Recovery—No. 1,506,803. Sept. 2, 1924. C. P. Astrom, East Orange, N. J. Molten slag or other material is poured from a ladle into pans set on a traveling conveyor. This conveyor passes through a conduit in which also passes a current of air. The heated air is then discharged to a boiler or other heat-utilizing device.

Flotation Reagent — No. 1,507,089. Sept. 2, 1924. Ludwig Rosenstein, San Francisco. A method of producing alkali metal xanthates, consisting in bringing together an alkali metal hydroxide, water, alcohol, and carbon bisulphide. The patentee was until a few months ago connected with the Great Western Electro-chemical Works, which was the first plant to make and sell potassium xanthate in large quantities to flotation operators.

Copper Metallurgy — No. 1,507,581. Sept. 9, 1924. T. W. Cavers, Nickelton, Ont. The patent covers the introduction of steam into copper blast furnaces at the tuyère level, a practice which was tried out at the British America smelter two or three years ago with encouraging results.

No. 1,508,243. Sept. 9, 1924. W. G. Perkins and W. H. Beasley, London, England, assignors to Metals Production Co. of North America, Inc., New York City. Finely divided oxidized ore is heated in a reducing atmosphere to produce subdivided metallic copper, which is cooled in a reducing atmosphere and pressed into blocks.

No. 1,509,774. Sept. 23, 1924. W. G. Perkins, London, England, assignor to Metals Production Co. of North America, Inc., New York City. Crushed copper sulphide ore is roasted to the sulphate, then heated in the presence of reducing gas for such a short time and at such a low temperature as to reduce copper compounds without melting the copper and without fritting the gangue, so that the reduced material is obtained in a porous condition. The product is then leached with an ammoniacal solvent of copper in the presence of oxygen.

Cottrell Process—No. 1,507,687 Sept. 9, 1924. W. A. Schmidt, Los Angeles, assignor to International Precipitation Co., Los Angeles. Independently ionized gases containing suspended particles are deionized by subjecting them to a purely electrostatic field of high intensity, following which the particles are precipitated by the usual Cottrell method.

No. 1,508,331. Sept. 9, 1924. F. W. Huber, Riverside, Calif., assignor to Western Precipitation Co., Los Angeles. Cement-kiln dust containing potash, is precipitated by the Cottrell Process, and the gases then are brought in contact with an electrically conductive material having the property of de-electrifying them.

Petroleum Drilling — No. 1,507,718. Sept. 9, 1924. J. L. Rich, Ottawa, Kan. A process for extracting petroleum by underground workings.

New Machinery and Inventions

Hollow Drill Steel by a New Process

A Clean Almost Perfect Hole, With Smooth Walls, Is Produced by Metal Core Rolling

A PROCESS of making a hollow drill steel having a hole with a wall so smooth and round that it resembles the bore of a rifle barrel was patented abroad about three years ago and in the United States in May, 1923. This is known as the metal core rolling process, and the patentee is John Bedford & Sons, Ltd., of Sheffield, England, a firm that has been making solid steel since 1792. The hole is so satisfactory, it is claimed, that any length of the hollow steel readily permits the uninterrupted passage from one end to another of a steel ball or rod of slightly smaller gage.

The process of making the hole is one by which a metal rod is inserted into the hot (and previously pierced) billet, the billet and rod then being rolled down as one, the rod then being drawn out, leaving a clean hole in the bar. The wall of the hole is entirely free from serious defects, a finish, it is claimed, which has never been hitherto obtained on a commercial scale.

The maker points out that this process must not be confused with the mandrill rolling process, in which a steel mandrill is inserted into the hollow billet during the earlier part of its reduction and then withdrawn, and the rolling process of the bar completed without any internal support of the walls of the hole against the pressure of the rolls. In the new metal core rolling process the central metal rod remains in the bar all the time, being reduced in size as the bar itself is reduced, until the rolling is completely finished, after which it is extracted.

Every bar of hollow steel made thus is specially heat treated, which gives the steel an extra toughness in working and a high resistance to fatigue. The heat-treating furnaces are equipped with pyrometers. As a further check and to verify the process, Brinell hardness tests are made upon the bars. Should the hardness in any instance fall outside the limits which experience has shown to be desirable, the bars are set aside for investigation. The manufacturer states, though, that irregularities of the finished material practically never occur.

Finally, the bars are machine-straightened and each bar is thoroughly examined for defects. At this stage a piece is broken off each end of the bar and the fractured ends are carefully examined for soundness, the hole also being gaged to insure that the final size has been obtained. The bars are then painted, bundled and marked ready for shipment.

The steel from which the billets are made is produced in electric furnaces. In the forging process that follows, the cast ingots are re-heated from the cold in a furnace and forged down under a 5-ton steam hammer. The partly forged ingot is cut into several pieces, which are again heated, and the forging is continued down to the required size of round billets and nicked to the necessary lengths. After going quite cold, the billets are broken off at the nicks, the fractures at this stage affording a most searching test for perfect soundness of the interior of the material. Each billet is then submitted to a special grinding process all over its surface and scrutinized for surface defects, following which the process of metal core rolling is continued.

John C. Pape, of 246 Main St., Madison, N. J., is the sole agent in the United States for Bedford products. Arrangements are being made for allotting stocks and agencies.

Novel Features Embodied in Cutting Torches

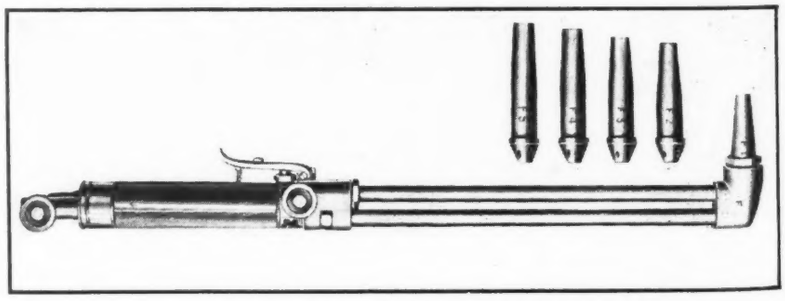
Two new styles of cutting torches, styles E and F, one of which is shown in the accompanying illustration, are being made by the Purox Company, of Denver, Colo. These torches, the manufacturer claims, operate efficiently on oxygen, in combination with acetylene, hydrogen, or other combustible gas, and can be used when desired for welding, as well as for cutting, the transformation to welding torch being effected by means of a welding tip adapter which can be supplied with either torch and cuts off the high-pressure oxygen flow.

The materials used are as follows: Tobin-bronze drop-forged front head; Tobin-bronze tubes, Tobin-bronze drop-forged mixing chamber; manganese bronze level; and stainless-steel lever latch, pawls, screws and valve parts.

Special features of the design are: Mixer location at the front of the handle, remote from the heat at the tip, insuring safety in operation, constancy of pre-heating flame, and an easily manipulated, well-balanced torch; perfectly smooth tubes, free from all obstructions, permitting easy, comfortable guidance; easily removable front end tubes, permitting the use of special tubes of any required length and the use of 45, 60, 75, or 90-deg. head angles according to the operator's convenience. The front end can be changed by merely unscrewing two nuts at the juncture of the handle and the front end. The mixer can also be changed, quickly and easily, in the same manner, to accommodate changes from oxy-acetylene to oxy-hydrogen or any other oxygen-fuel combination.

Being assembled in units, the torches can easily be repaired in the field by ordinary mechanics.

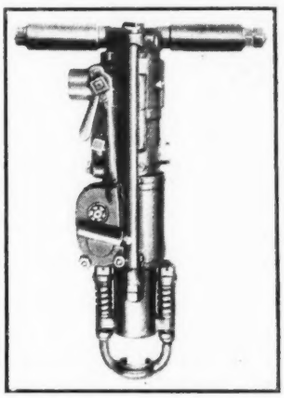
The capacity of these torches is rated conservatively and can be attained by any cutter. Style F, it is claimed, can cut material of any thickness likely to be met in steel foundry or steel-mill operations.



A new cutting torch with removable front end tubes

New Model Hand-hammer Drill Recently Introduced

The danger of stuck steel can be eliminated by rotating the drill steel independently of the hammer action, which is one of the features of the new model 37 Turbro Waughammer. A circular just issued by the Denver Rock Drill Manufacturing Co., Denver, Colo., describes this machine, a photograph of which is reproduced herewith. This new sinker is suited to all classes of work where hand-hammer drills are used, either for heavy ground or where high speed is desired. The automatic valve is of unique design; it is of the differential tubular type, giving particularly efficient use of air and an almost total lack of vibration.



The new model 37 Waughammer

The simplicity of the hammer is a feature. It has no rifle flutes and is free to float in the cylinder. A swivel air connection is provided, which is more convenient than the usual rigid connections. The air water tubes can be quickly removed through the back head. Ordinarily this model is furnished for dry-drilling but is readily convertible into a wet machine.

The principle of rotation used is identical with that of the Model 31.

The Market Report

Daily Prices of Metals

Oct.	Copper, N. Y. net refinery	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
9	12.625@12.70	48.625	49.125	8.00	7.80	6.20
10	12.75	49.25	49.75	8.00	7.80	6.225
11	12.75	49.125	49.625	8.05	7.80	6.25
13	.....	.....	.....	....	.....	.....
14	12.875	49.50	50.00	8.05	7.80@7.85	6.30
15	12.875	49.375	49.875	8.05	7.80@7.85	6.30
Av.	12.783	49.175	49.675	8.03	7.810	6.255

*These prices correspond to the following quotations for copper delivered: Oct. 9th, 12.875@12.95c.; 10th and 11th, 13.00c.; 14th and 15th, 13.125c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Oct.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
9	61¾	62¾	65¾	241½	243¾	34⅝	33 7/16	33⅛	32⅞
10	62	63	65¾	244¼	246½	34½	33½	33	32⅞
13	62⅜	63¾	66¼	245¼	247¼	34⅝	33½	33 5/16	33⅛
14	62½	63½	66½	245¼	247⅜	35	34	33⅜	33 3/16
15	62⅞	63⅞	66¾	244¾	247½	35 11/16	34¼	33 5/16	33 3/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Oct.	Sterling Exchange "Checks"	Silver		Gold London	Oct.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
9	4.47⅜	72⅛	36 1/16	92s 5d	13	.....	...	35⅜	92s 2d
10	4.49	72	35⅞	92s 3d	14	4.49½	71⅛	35 7/16	92s 3d
11	4.48½	71⅝	35¾	.... ..	15	4 48¾	71⅝	35 9/16	92s 2d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

All Metal Prices Make Moderate Advance

New York, Oct. 15, 1924—All of the more important non-ferrous metals advanced in price during the week ending today, though no sensational price changes can be recorded. The demand was not particularly active, and the holiday on Monday certainly cut into the total of sales, so it was probably the improved conditions abroad that affected the market. The success of the German loan, which was heavily oversubscribed yesterday, and the likelihood of German business being much stimulated by private credits, made things look brighter for the metals. But aside from the sentimental aspect, there has been a very real and sustained demand for copper, lead, and zinc in Europe recently that has taken a substantial tonnage off the domestic market.

Copper Now 13⅛c., Delivered

A week ago copper was difficult to sell at 12¾c., delivered, but so little was offered at that level that it was quickly absorbed. In fact, at no time was it possible to buy copper for delivery later than November at that price. The demand picked up materially on Saturday, and several million pounds were sold on that day at 13c., delivered. Over the week-end, increased strength was evident in London, so that yesterday producers here were firmly intrenched at 13¼c. A very fair tonnage was sold at that figure, which was quoted by practically all sellers for Eastern deliveries. In the Middle West, 13¼c. was done. Today, the market is substantially unchanged, though a slightly stronger tone is again in evidence, in line with a slight advance in London.

Most of the business has gone to wire and brass mills, the last named showing more interest in the market than for some time. Practically all of the metal has been for delivery in the next three months; for early 1925 delivery, producers would be inclined to quote higher prices, but the demand has not yet asserted itself.

The quarterly statistics mentioned last week have been released and will be found at length on page 639 of this issue. Though showing an increase in stocks, the market advanced, indicating that no fears are entertained on this score.

Foreign demand for copper has been good all week, especially from England, France, and Germany. Most of the metal has been sold for 13.15@13.20c., c.i.f., but yesterday and today, 13.25@13.35c. has been done.

Some Lead Sold at Premium

The official contract price of the American Smelting & Refining Co. continues at 8.00c., New York.

The lead market is virtually unchanged, though demand is perhaps a little more active that it was a week ago. Possibly the most interesting feature of the market has been the fact that holders of desilverized lead in the East, especially those who have metal available for prompt shipment, have been able to get a premium above the established 8c. level of recent weeks. Several hundred tons of lead have been sold at 8.10@8.15c. during the week ending today, though most of the demand is still being supplied at the even figure. In St. Louis, the market seems to teeter between 7.80 and 7.825c., though today it is doubtful if much lead could be obtained for the lower figure. Lead for shipment six or eight weeks hence has sold for 7.85c., St. Louis, and 7.90c. has been obtained in Chicago for early delivery.

The foreign demand continues excellent, and it is probable that the somewhat meager supplies in the East are due to free selling abroad to hold the market there in check. Missouri producers are also practically out of the Eastern market, for they must pay a freight rate of 35c. per 100 lb., which is considerably higher than the proportional through rate from points further west.

Zinc Advances to 6.30c.

Domestic users of zinc have not been much interested in the market, but good orders have been received for ex-

port, which has helped the situation materially. There are few anxious sellers at present prices, for it is felt that galvanizers have bought such modest tonnages in recent weeks that the demand is likely to increase at any time, with a coincident upward movement of prices.

Statistics recently issued by the American Zinc Institute, for September, are as follows:

Stock, Sept. 1	50,922
Produced	40,852
	91,774
Shipped	46,054
Stock, Sept. 30	45,720
Shipped from plant for export	5,640
Stored for customers	1,640
Retorts operating, Sept. 30	70,875

High-grade zinc continues unchanged at 8@8¼c. delivered in the East, with a satisfactory demand.

Tin Again Reaches 50c.

The tin market is substantially unchanged so far as consumers' demands are concerned, though the market has been slightly more active at the higher levels cabled from London. Strength in sterling has also helped so that in the last two days the 50c. level of mid-September has again been reached here. Forward deliveries continue to be neglected; three months' tin is now somewhat higher than spot, though the difference is not more than ¼c. Arrivals of tin to and including Oct. 13 totaled 2,405 long tons, according to the New York Metal Exchange.

Circulation Statement

The circulation statement of United States money for Oct. 1, 1924, as issued by the Treasury Department, shows the following stock of money:

Gold coin and bullion	$4,547,785,214
Standard silver dollars	505,952,851
Subsidiary silver	276,967,574
United States notes	346,681,016
Federal Reserve notes	2,230,536,580
Federal Reserve Bank notes	9,448,170
National Bank notes	775,826,844
Total	$8,693,198,249
In circulation per capita	$42.52

During September, gold and silver stocks increased by approximately $18,000,000 and notes outstanding, by $2,000,000.

Foreign Exchanges Up

Most of the European exchanges have exhibited slight advances during the week, sterling reaching a new high on the present movement yesterday. On Tuesday, Oct. 14, closing cable quotations on francs were 5.24c., and on lire, 4.3725c. Canadian dollars continue at 1/32 per cent discount.

Silver Slightly Lower

Silver declined last week, the market having apparently advanced too rapidly. Buyers have been inclined to hold off, and speculative selling is in evidence. There is no fundamental change in the situation.

Mexican Dollars — Oct. 9th, 55½c.; 10th, 55⅜c.; 11th, 54⅞c.; 13th, holiday; 14th, 54⅝c.; 15th, 54¾c.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 28c. per lb.; 98 per cent, 27c. London, £125 per long ton.

Antimony—Per lb.:
Chinese and Japanese brands, 11¼@11¼c., nominal. Market quiet.
Cookson's "C" grade, 14¼@14½c.

Bismuth—$1.85@$1.90 per lb. London, 7s. 6d.

Cadmium—60c. per lb. London, 2s. 5d.

Iridium—$260@$270 per oz.

Iridium alloyed with platinum, $280@$286.

Nickel—29@30c. per lb. for 99 per cent virgin metal. Electrolytic, 33c.; London, £160 per long ton.

Palladium—$82@$83 per oz. Beginning Oct. 15, one of the leading interests quoted $83 firm. Crude, $60@$65.

Platinum:
Refined, $118 per oz.
Crude, $112@$114.

Quicksilver—$71 per 75-lb. flask. San Francisco wires $72; London, £11¾.

The prices of **Cobalt, Germanium Oxide, Magnesium, Molybdenum, Monel Metal, Osmiridium, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten,** and **Zirconium** are unchanged from the prices given in the Oct. 4 issue.

Metallic Ores

Chrome — $18.50@$24, depending upon grade and source. Nominal.

Manganese — 41@45c. per long ton unit, seaport, c.i.f. Nominal.

Molybdenum — 70@75c. per lb. of MoS_2 for 85 per cent concentrates. Nominal.

Tungsten Ore—Per unit, N. Y.:
High-grade wolframite, $8.50@$8.75.
High-grade scheelite, $9.
Ordinary grades, $8.25. Nominal.

Iron Ore, Galena and **Pyrite Radio Crystals, Tantalum,** and **Vanadium Ores** are unchanged from Oct. 4 quotations.

Zinc and Lead Both Higher

Joplin, Mo., Oct. 11, 1924

Zinc Blende	Per Ton
High	$44.60
Premium, 60 per cent zinc	$42.50@$43.00
Prime Western	41.00@$42.00
Fines and slimes	40.00@$38.00
Average settling price, all	$41.46
Lead Ore	
High	$109.95
Basis 80 per cent lead	$107.50@$110.00
Average settling price, all	$106.11

Shipment for the week: Blende, 14,578; lead, 3,058 tons. Value, all ores the week, $928,890.

Buyers were holding offerings down to last week's level until noon today, with sellers declining to accept, when with a few exceptions, a half dollar advance was made. Since noon one company came into the market for 9,500 tons and lifted offerings $1 and $1.50 per ton.

Buyers report lead on $107.50 basis, but some lead is known to have sold on $110 basis.

Platteville, Wis., Oct. 11, 1924

Zinc	Per Ton
Blende, basis 60 per cent zinc	$44
Lead	
Lead, basis 80 per cent lead	$108

Shipments for the week: Blende, 375 tons; lead, none. Shipments for the year: Blende, 23,805; lead, 800 tons. Shipments for the week to separating plants, 1,593 tons blende.

Non-Metallic Minerals

Magnesite — Calcined, $32@$35 per 2,000 lb. Demand falling off owing to importations.

Amblygonite, Asbestos, Barytes, Bauxite, Beryl, Borax, Celestite, Chalk, China Clay, Corundum, Diatomaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Gypsum, Ilmenite, Iron Oxide, Lepidolite, Limestone, Manjak, Mica, Monazite, Ocher, Ozocerite, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystals, Rutile, Silica, Spodumene, Sulphur, Talc, Tripoli and **Zircon** are unchanged from Oct. 4 prices.

Mineral Products

Arsenious Oxide (white arsenic)—7c. per lb.

Copper Sulphate—4.40@4.65c. per lb.

Sodium Nitrate—$2.40 per 100 lb.

Sodium Sulphate—$17@$18 per ton, New York.

Potassium Sulphate and **Zinc Oxide** are unchanged from Oct. 4 prices.

Ferro-Alloys

Ferromanganese—Both domestic and English advanced to $100 per gross ton.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and Ferrovanadium are unchanged from the prices given in the Oct. 4 issue.

Metal Products

Rolled Copper—Sheets, 20¼c. base; wire, 15¼c.

Lead Sheets, Nickel Silver, Yellow Metal and **Zinc Sheets** are unchanged from Oct. 4 prices.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick, and **Zirkite** are unchanged from Oct. 4 prices.

Iron Trade Dull But Steady

Pittsburgh, Oct. 14, 1924

The steel market in general promises to continue being a highly competitive one. With the "Pittsburgh Plus" system eliminated, mills generally are endeavoring to retain former customers, even to the extent of absorbing several dollars a ton of the freight when occasion requires.

Pig Iron—The local market has been particularly dull, but with prices well held at $20 for bessemer, $19 for basic, and $19.50@$20 for foundry, Valley basis.

Connellsville Coke—The tone of the market is easier, without change in quotable prices. Spot furnace, $3@$3.10; spot foundry, $4@$4.50.

Safeguarding German Raw Aluminum

By Dr. James Rubinfeld, Berlin

ON SAILING for Europe in mid-August of the current year, President Davis of the Aluminum Company of America said to those interviewing him: "We are stocking our shelves in anticipation of future needs of merchants. We are handling only domestic business because we cannot stand German competition in the world market. We have to pay a man $4.50 a day, while Germany can get the same work done for 35 to 40c. Without a protective tariff we should be swamped by Germany."

The moment these words or similar ones had been uttered the German aluminum producers were urging their government that measures be adopted to protect their product from foreign competition on the home market, by which only American competition could be meant after the "shelves had been stocked" over there.

Although it is common knowledge here that the Aluminum Company of America had in recent times had to resort to Norwegian arrivals in meeting the tremendous American requirements, the managers of the German state-owned works are possessed with the bogey of a possible future dumping by foreigners whenever the American market would lose its ability to absorb the usual quantities from current production. In such case the American aluminum producer might not hesitate to adopt methods which are customary with other powerful producers, like the Standard Oil Co., the more so as the Aluminum Company of America is the sole party concerned which does not join in the existing agreement between all European producers of the light metal, and thus is well able to cut prices on the open market here. On the other hand, the German industry is very young and wants a period of protection to develop gradually from the hasty and fortuitous state in which it was operated during war times into a cheap producer by water power and not by brown coal, as has been the case hitherto.

Even the co-partners of the Germans in the International Agreement who were vigorously opposed by the latter in the intention to put up the price to 3.2 Swiss francs a kilo, seem to infuse the Germans with fear lest the Swiss, French, and other imports might take the shape of alloys or scrap at low prices by which some foundries here are being allured, and thus to discredit, not the foreign article (the German experts are of opinion that also their electrolytically refined aluminum is much superior to foreign material), but the use of aluminum at all, to the detriment of the young trade. Therefore, producers here insist on a duty of 10 per cent or so ad valorem to be imposed on aluminum coming across the frontiers. This duty, however, shall be regarded as *ultima ratio* in case of need and not in regular times as the present.

Germany for the Germans! is the slogan of the aluminum producers in face of an alleged competitive threat from abroad, and they are pointing out the fact that the raw material for making aluminum and magnesium is the sole one which, so far as geologists assert, is to be got in sufficient proportions in domestic earth. Accordingly, an impoverished country like Germany cannot afford to take in foreign substitutes so long as there is a way to improve the trade balance in metallic commodities.

Now, the rolling mills are just those which arbitrarily used to add to "standing-in" prices under the plea of being themselves compelled to buy Swiss francs on the open market with which to pay raw aluminum purchases. Incidentally, since the rentenmark stabilization one can get as much of foreign payment means for rentenmark as he likes. These same mills are at the forefront to combat the suggestions of the domestic producers by insisting on absolutely free entrance of the foreign product because, they state, there may sometime be a productive shortage at home and rollers might then be forced to resort to foreign material. The latter objection seems somewhat far fetched because the German raw aluminum producers have always been able to meet the domestic demands during the last few years except during the stoppage of the western Grevenbroich mill owing to the passive resistance in the Ruhr.

The German productive capacity for the rawstuff before the starting of the Inn-Werk—to produce at least 12,000 a month—may be put roughly at 1,700 tons monthly, whereas the present genuine requirements hardly exceed 1,000 tons, owing to strong competition on the Indian market by the British and other rolling mills. Then it must be said that as a rule foreign semi-finished aluminum is allowed to enter the country even under the present import restrictions whenever the domestic manufacturer declares himself unable to grant the same terms as the foreign supplier.

On the other hand, the German tender must be favored by the user. The campaign of the rolling mills against the proposed means of safeguarding the aluminum industry has at its root the fact that the latter has, by joining the price convention of other European producers, cut through the former possibilities of cheaper "standing-in" costs for the material of German origin. Only for aluminum wire bars do the raw aluminum mills grant a good discount. The customer must show that it is to be used for electric lines, so that copper is then superseded by the domestic metal. Notwithstanding this rebate of 22 Swiss centimes for a kilo, the use of aluminum for electricity transmission purposes has much diminished recently owing, of course, to the heavy fall of copper and the rise of aluminum quotations in comparison with pre-war times.

The bad condition of the automobile trade, which has to lead an uphill fight against the cheap cars of Henry Ford, is persistently but unjustly put down to high aluminum costs instead of to obsolete working methods. There is no evidence for the statement that the French and Swiss raw aluminum producers used to grant rebates to their compatriots with the view to further the aluminum manufacturing trades of the respective countries. In our mind, the problem of interchange of aluminum between the producing and manufacturing countries will in future be freed of artificial factors. For the time being, however, the problem of the young aluminum industry of Germany presents many queries.

Fortunately, the Vereinigte Aluminum Werke of Lauta is excellently managed by Mr. von der Porten, who sees the international situation of the light metal very clearly. It is to be credited to his initiative that the construction of the Bavarian water-power plant has been completed, so that the economic advantage of the Swiss affiliations in the German localities of Bergheim, Bergschmiede, and Mundenheim in making use of indispensable German coal fields when working ore into raw aluminum soon will be much reduced.

Copper Consumption on Unprecedented Scale

The current year may be expected to set a new record for copper consumption, according to statistics for the first nine months, just released, which show the deliveries to have averaged 13,084 tons per month more than for the year 1923, and 32,415 tons per month more than for 1922.

The production of refined copper in 1924 by North and South American producers, and the total deliveries, both domestic and export, are as follows:

Period	Refined Production, Tons	Total Deliveries, Tons
First quarter	326,928	363,351
Second quarter	323,535	330,802
Third quarter	316,197	291,637
Nine months	966,660	985,790
Monthly average	107,407	109,532

The only fly in the ointment here is that production has not dropped off quite so fast as deliveries, from the record figures made in the first quarter, so that recently somewhat more copper has been produced than has been consumed. However, the stocks of refined copper at the end of September were only 136,751 tons, which is but little over a month's production. The stocks on Jan. 1, 1924, were 155,885 tons.

The relative deliveries for domestic and foreign destinations are of interest:

Period	Domestic Shipments, Tons	Export Shipments, Tons
First quarter	223,649	139,702
Second quarter	195,126	135,676
Third quarter	159,408	132,229
Nine months	578,183	407,607
Monthly average	64,242	45,289

The interesting thing about these summaries is the fact that the demand for copper for export has declined but little; it is the domestic demand that has weakened.

Mining Stocks

Week Ended October 11, 1924

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Alaska-Br. Col.	N. Y. Curb	...	...	*37	...	...
Anaconda	New York	37	35¼	35⅝	De.15, Ja.21, Q	0.75
Arcadian Consol.	Boston	1⅛	1	1	...	...
Ariz. Com'l.	Boston	10⅛	9½	10	Jy.19, Jy.31	0.50
Calaveras	N. Y. Curb	...	...	2	...	...
Calumet & Arizona	Boston	48½	47	48½	Se. 5, Se. 22 Q	0.50
Cal. & Hecla (New)	Boston	15	14⅛	14⅛	My. 31, Jn. 16	0.50
Canario Copper	N. Y. Curb	3⅞	3⅞	3⅞	...	...
Cerro de Pasco	New York	47	45	45⅝	Jy. 17, Au. 1	1.00
Chile Copper	New York	32⅞	31⅛	31⅜	Se.3, Se.29, Q	0.62½
Chino	New York	20	18½	20	Sept., 1920,	0.37½
Con. Coppermines	N. Y. Curb	3 5/16	2⅞	3⅛	...	...
Copper Range	Boston	23	21	22⅛	May, 1923	1.00
Crystal Copper	Boston Curb	*67	*60	*63	...	...
Davis-Daly	Boston	*41	*40	*41	Mar., 1920	0.25
East Butte	Boston	4	3⅞	4	Dec., 1919	0.50
First National	Boston Curb	*40	*37	*37	Feb., 1919,	0.15
Franklin	Boston	*70	*40	*55	...	...
Gadsden Copper	Boston Curb	*66	*65	*65	...	...
Granby Consol.	New York	18⅝	17⅛	18⅛	May, 1919	1.25
Greene-Cananea	New York	15	14⅞	15	Nov., 1920	0.50
Hancock	Boston	...	...	1	...	...
Howe Sound	N. Y. Curb	2⅜	2⅛	2⅜	Ap.1, Ap.15, Q	0.05
Inspiration Consol.	New York	25½	24⅛	24⅝	De.20, Ja.7, Q	0.50
Iron Cap	Boston Curb	2⅝	2⅜	2½	May, 1923	0.15
Isle Royale	Boston	16⅛	13½	15	Se. 1, Se. 15,	0.50
Jerome Verde Dev.	N. Y. Curb	...	...	*95	...	...
Jib Consol	N. Y. Curb	*60	*50	*50	...	...
Kennecott	New York	46⅜	44⅛	45⅛	Se.5, Oc.1, Q	0.75
Keweenaw	Boston	*65	*65	*65	...	...
Lake Copper	Boston	1⅜	1⅜	1⅜	...	...
Magma Copper	New York	35	32½	34	Jan., 1919	0.50
Mason Valley	N. Y. Curb	1⅜	1⅛	1⅜	...	...
Mass Consolidated	Boston	1	1	1	Nov., 1917	1.00
Miami Copper	New York	21⅛	21	21⅛	No.1 No.15 Q	0.50
Mohawk	Boston	33	29	31⅛	Se. 22, Oc. 13,	1.00
Mother Lode Con.	New York	7⅜	7⅛	7⅜	Jn.13, Jn.30	0.37½
Nevada Consol.	New York	14	13⅜	13⅞	Sept., 1920,	0.25
New Cornelia	Boston	20½	19⅞	20⅛	Au.8, Au.25,	0.25
New Dominion	N. Y. Curb	...	...	2⅜	...	...
North Butte	Boston	3⅛	1⅞	2⅛	Oct., 1918,	0.25
Ohio Copper	N. Y. Curb	1⅛	1	1	...	...
Old Dominion	Boston	21	19	21	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†115	†112	...	Se.20, Oc.1 Q	1.00
Quincy	Boston	22	18½	21	Mar., 1920	1.00
Ray Consolidated	New York	12⅛	11⅞	12⅛	Dec., 1920	0.25
Ray Hercules	N. Y. Curb	*15	*15	*15	...	...
St. Mary's Min. Ld.	Boston	34	32⅛	34	Ap.22, My.20	3.00
Seneca Copper	New York	1⅜	1⅜	1⅜	...	...
Shannon	Boston	*75	*75	*75	Nov., 1917	0.25
Shattuck Arizona	New York	6	6	6	Jan., 1920	0.25
Superior & Boston	Boston	1⅛	1 1/16	1 1/16	...	...
Tenn. C. & C. cfs.	New York	7⅜	7⅛	7⅛	De.31, Ja.15, Q	0.25
United Verde Ex	N. Y. Curb	26	25½	25⅞	Oc.3, No.1	0.50
Utah Copper	New York	79⅛	74	78⅛	Se.15, Se.30, Q	1.00
Utah Metal & T.	Boston	*25	*25	*25	Dec., 1917	0.30
Victoria	Boston	...	...	*50	...	...
Walker Mining	N. Y. Curb	3	3	3	...	...
Winona	Boston	...	...	*35	...	...
NICKEL-COPPER						
Internat. Nickel	New York	19	17⅛	18⅜	Jy.17, Au.1, Q	1.50
Internat. Nickel pfd.	New York	89⅞	89¼	89⅞	Oc.16, No.1, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	†3½	†3½	...	...	...
National Lead	New York	153⅜	150¼	150½	Se.12, Se.30, Q	2.00
National Lead pfd.	New York	116½	116	116	Au. 27 Se. 15, Q	1.75
St. Joseph Lead	New York	34⅛	33	33⅜	De. 9, De.20	0.50
ZINC						
Am. Z. L. & S.	New York	7⅜	7	7⅛	May, 1920	1.00
Am. Z. L. & S. pfd.	New York	28⅛	25⅛	25⅛	Nov., 1920	1.50
Butte C. & Z.	New York	5⅛	5	5⅛	Ma., 1922	0.50
Butte & Superior	New York	16⅜	16	16⅛	Je.15, Je. 30, Q	0.50
Callahan Zn-Ld.	New York	3⅛	3	3	Dec., 1920	0.50
New Jersey Zn.	N. Y. Curb	166	159¾	165¾	Oc.,No.,'24 QX	4.00
United Zinc	N. Y. Curb	...	...	*25	...	...
Yellow Pine	Los Angeles	...	...	56	June, 1924	0.04
SILVER						
Alvarado	N. Y. Curb	3	3	3	...	...
Beaver Consol.	Toronto	*20	*16½	*16½	May, 1920	0.03
Castle-Trethewey	Toronto	*71½	*70½	*70½	...	...
Coniagas	Toronto	2.25	2.00	2.00	Ap.20, My.1	0.02½
Crown Reserve	Toronto	*63	*47	*53	Jan., 1917	0.05
Keeley	Toronto	2.35	2.24	2.34	Sept. 15, SA	0.12
Kerr Lake	N. Y. Curb	...	...	1⅞	Oc. 1, Oc. 15,	0.12½
La Rose	Toronto	*8	*8	*8	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto	1.45	1.44	1.45	...	...
McKinley-Dar.-Sav.	Toronto	*12	*11½	*11½	Oct., 1920	0.03
Mining Corp. Can.	Toronto	2.75	2.70	2.75	Sept., 1919	0.12½
Nipissing	N. Y. Curb	6⅛	6	6	Oc.1, Oc.20, QX	0.30
Ontario Silver	New York	8⅛	7⅞	8⅛	Jan., 1919	0.50
Temiskaming	Toronto	*20	*19	*20	Jan., 1920	0.40
GOLD						
Alaska Gold	New York	⅞	⅞	⅞	...	...
Alaska Juneau	New York	1⅛	1	1	...	...
Argonaut	Toronto	*35	*32½	*34	...	...
Carson Hill	Boston	...	...	1	...	...
Cresson Consol. G	N. Y. Curb	3⅛	3⅛	3⅛	Se.30, Oc.6, Q	0.10
Dome Mines	New York	15	13⅞	14¼	Oc.3, Oc.20, Q	0.50
Golden Cycle	Colo. Springs	...	...	1.25	My.31, Jn.10 Q	0.03
Hollinger Consol.	Toronto	14.80	14.65	14.65	Oc.16, No.3, M	0.05
Homestake Mining	New York	46½	46	46½	Oc.20, Oc.25, M	0.50
Kirkland Lake	Toronto	*19½	*19	*19	...	...
Lake Shore	Toronto	3.94	3.89	3.90	Se.1, Se.15, Q	0.05
McIntyre-Porcupine	New York	15⅞	15⅝	15⅝	Au. 1, Se. 1,	0.25
Newray	Toronto	*24½	*23½	*23½	...	...
Portland	Colo. Springs	...	...	48	Oct., 1920	0.01
Teck-Hughes	Toronto	1.20	1.17	1.17	...	...
Tom Reed	Los Angeles	19	18½	19	Dec., '1919	0.02
Tough-Oakes	Toronto	*59	*56½	*56½	...	...
United Eastern	N. Y. Curb	*35	*35	*35	Jy.18, Jy.31, Q	0.05
Vipond Cons.	Toronto	1.29	1.27	1.27	...	...
Wright-Hargreaves	Toronto	3.65	3.65	3.65	Se.15, Oc. 1, Q	0.02½
GOLD AND SILVER						
Black Oak	N. Y. Curb	...	...	*89	...	...
Con. Cortez	N. Y. Curb	*13	*12	*12	...	...
Con. Virginia	San Francisco	8½	6½	6½	...	...
Continental Mines	N. Y. Curb	...	...	2¼	...	...
Dolores Esperanza	N. Y. Curb	*32	*32	*32	Jy. 1, Jy. 10 Q	0.05
Premier Gold	N. Y. Curb	2 5/16	2¼	2 5/16	Se.25, Oc 30	0.08
Tonopah Belmont	N. Y. Curb	...	...	*59	Apr., 1923	0.05
Tonopah Divide	N. Y. Curb	...	...	*24	Se.22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	3 1/16	3⅛	3⅛	Se. 10, Oc. 1	0.05
Tonopah Mining	N. Y. Curb	1⅜	1⅜	1⅜	Se. 30, Oc. 21	0.07½
Unity Gold	N. Y. Curb	...	...	1¼	...	...
West End Consol.	N. Y. Curb	*68	*60	*60	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	...	...	*50	June, 1918	0.02
SILVER-LEAD						
Ahumada	Boston Curb	6½	6⅛	6½	Se.16, Oc. 2, X	0.15
Bingham Mines	Boston	...	...	16½	Sept., 1919	0.25
Cardiff M. & M.	Salt Lake	...	...	*75	Dec., 1920	0.15
Chief Consol.	Boston Curb	2½	2⅛	2⅜	Ap.19, My.1, Q	0.10
Columbus Rexall	Salt Lake	28	25½	26	Aug., 1920	0.03
Consol. M. & S.	Montreal	44	41½	43¾	Jn.30, Jy.15	0.75
Daly Mining	Salt Lake	2.00	2.00	2.00	July, 1920	0.10
Erupcion	Boston Curb	...	...	2½	Se. 15, Oc.2, X	0.15
Federal M. & S.	New York	...	...	12⅛	Jan., 1909	1.50
Federal M. & S. pfd.	New York	50	48½	50	Au.25, Se.15, Q	1.75
Florence Silver	Spokane	9	5⅛	5½	Apr., 1919, QX	0.01
Hecla Mining	N. Y. Curb	9¾	9⅛	9⅞	Sept. 15, 1924	0.25
Iron Blossom Con.	N. Y. Curb	*25	*25	*25	Oct., 1923	0.02
Marsh Mines	N. Y. Curb	...	...	*5	June, 1921	0.02½
Park City	Salt Lake	...	...	4.45	Se.15, Oc.1,	0.15
Park Utah	N. Y. Curb	...	...	3⅛	Mc.15, Ap.1	0.15
Prince Consol.	Salt Lake	*8⅛	*7⅞	*8⅛	Nov., 1917	0.02
Silver King	N. Y. Curb	...	...	*50	Se.20, Oc.1,	0.15
Silversmith	Spokane	*29	*28	*28	Oc.1, Oc. 10,	0.01
Tamarack-Custer	Spokane	1.38	1.34	1.37	Se.22, Se.29,	0.25
Tintic Standard	Salt Lake	7.00	6.80	7.00	Se.1, '24, X	0.25
Utah-Apex	Boston	2⅛	2 1/16	2⅛	Se.5, Se.15, Q	0.25
IRON						
Bethlehem Steel	New York	44⅜	43	43½	Jn.1, Jy.1, Q	1.25
Char. Iron	Detroit	*30	*30	*30	...	...
Char. Iron pfd.	Detroit	*80	*75	*75	...	...
Colorado Fuel & Iron	New York	43	38	39½	Au.11, Au. 25 Q	2.00
Col. Fuel & Iron pfd.	New York	...	...	108½	Feb., 1923	2.00
Gt. North'n Iron Ore	New York	29⅞	29⅛	29⅛	De.10, De.27	2.00
Inland Steel	N. Y. Curb	...	...	46	Au.15, Se.1 Q	0.62½
Mesabi Iron	N. Y. Curb	...	...	2¾	...	...
Replogle Steel	New York	11½	11	11	...	...
Republic I. & S.	New York	46¾	44⅞	44⅞	May, 1921	1.50
Republic I. & S. pfd.	New York	86	86	86	Se.15, Oc.1, Q	1.75
Sloss-Sheffield S.&I.	New York	70½	68½	69	Se.11, Se.20, Q	1.50
Sloss-Shef. S.&I.pfd.	New York	...	...	89	Se.20, Oc.1, Q	1.75
U. S. Steel	New York	108¾	106⅞	107	Se.1, Se.29 QX	1.75
U. S. Steel pfd.	New York	122½	122	122⅝	Au. 5, Au. 30 Q	1.75
Virginia I. C. & C.	New York	...	...	71	De.15, Ja. 2	1.50
Virginia I.C.&C.pfd.	New York	...	...	89	Jn.17, Jy.1	2.50
VANADIUM						
Vanadium Corp.	New York	23½	22⅝	22⅝	Jan., 1921	1.00
ARSENIC						
Western Utah Copper	N. Y. Curb	*16	*16	*16	...	...
ASBESTOS						
Asbestos Corp.	Montreal	...	...	26⅞	Se.29, Oc.15 Q	1.00
Asbestos Corp. pfd.	Montreal	...	...	68	Oc.1, Oc.15, Q	1.50
SULPHUR						
Freeport Texas	New York	8	7⅞	7⅞	Nov., 1919,	1.00
Texas Gulf	New York	79	77	77¾	Se.2, Se.15, QX	1.75
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	...	...	4½	...	...
MINING, SMELTING AND REFINING						
Amer. Metal	New York	46¼	45⅛	46	Au. 18, Se. 2 Q	0.75
Amer. Metal pfd.	New York	...	...	113	Au.20, Se. 2, Q	1.75
Amer. Sm. & Ref.	New York	75½	73	73½	Oc.17, No.1, Q	1.25
Amer.Sm.&Ref.pfd.	New York	104	103	103½	No.17, De.1, Q	1.75
U. S. Sm. R. & M.	New York	36	32	33⅛	Jan., 1921,	0.50
U.S. Sm. R.&M.pfd.	New York	46	43⅞	43¾	Oc.9, Oc.15 Q	0.87½

* Cents per share † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Movsey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Colorado Springs, Colorado Springs Stock Exchange.